McGraw-Hill Co., Inc. Nov. 16, 1921 25 cents per copy

CHEMICAL & METALLURGICAL ENGINEERING

Chromel

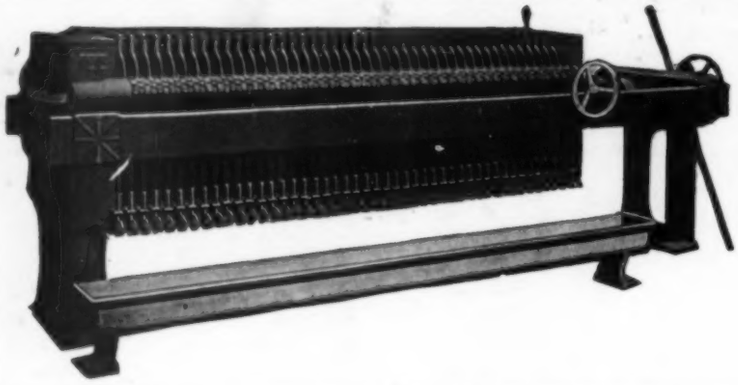
Creator of Electric Heat

When CHROMEL was discovered, the electric heating industry came into existence and pyrometry was given its most valuable thermo-couple alloy. The splendid service that laboratories and factories secure from Hoskins electric furnaces, and the dependability of Hoskins pyrometers and thermo-couples, are based on the unique heat-resisting properties of CHROMEL.

HOSKINS MANUFACTURING CO., Detroit

Boston New York Pittsburgh Cleveland Chicago San Francisco

HOSKINS PRODUCTS



Shriver Efficiency

Many years of producing filter presses for all types of filtration work enable us to guarantee the results.

This guarantee of efficiency goes with every filter press we sell—we know our product, and we are ready to stand back of it. Write for catalog stating your filtration problem.

T. SHRIVER & CO.
808 Hamilton Street, Harrison, N. J.

Coal that Flows like Water

Announcement

The Pulverized Fuel Systems and Engineering Department of the Quigley Furnace Specialties Co. have been acquired by the Hardinge Company, and will be operated as a department under the name of "Quigley Fuel Systems," with no change in personnel.

The Quigley Pulverized Fuel Systems handles coal so easily that it flows like water through an ordinary pipe. Just think of what this means! A clean plant, free from dust.

"Quigley Fuel Systems" means a complete plant—not just one part of the process. It takes the coal from the freight car, pulverizes it and breathes it into the furnace—in fact, even burns it.

HARDINGE COMPANY
120 BROADWAY, NEW YORK

Quigley Fuel Systems

MACMICHAEL VISCOSIMETER
No. 7367CM Disassembled

Macmichael Viscosimeter

Recommended for the testing of oils, varnishes, greases and glues. Employed also for testing a wide variety of other materials, the viscosity range being from that of the thinnest liquid up to the thickest glue.

Used to determine the "body" of cocoa solutions, patent medicines, starches, etc. The instrument is portable and rugged in construction. Technical training is not required to operate. The motor is universal for A.C. or D.C. In ordering, advise voltage of current, also approximate range of viscosity of the materials to be tested, so that suitable torsion wires may be supplied.

Write for Bulletin No. 280, giving full details of the above apparatus.

EIMER & AMEND

New York City
200 East 19th Street

Established 1851

Pittsburgh Branch
4048 Jenkins Arcade

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE

H. C. PARMELEE, Editor
ELLWOOD HENDRICK, Consulting Editor
ERNEST E. THUM, Associate Editor
SIDNEY D. KIRKPATRICK, Assistant Editor

ALAN G. WIKOFF
R. S. McBRIDE
CHARLES N. HULBURT, Assistant Editors
CHESTER H. JONES, Industrial Editor
J. S. NEGRU, Managing Editor

Volume 25 — New York, November 16, 1921 — Number 20

Armistice Day And a New Epoch

DULL indeed must be the mind and unsympathetic the soul that could remain unmoved by the impressive ceremonies in Washington and Arlington last Friday when America honored her nameless dead in the Great War. In the presence of a notable company representing the world's principal nations our own Unknown Warrior was honored with tributes that nations only can bestow.

The incident is rich in lessons that are not far to seek. They comprehend the obvious duties of those who are left to win the fruits of peace. We may not share the glory of this unknown soldier who fell on the field of battle, but we can and must accept the challenge of his sacrifice by doing the world's work better than it was ever done before. His death is also a challenge to the world's statesmen who are gathered in Washington to find ways of promoting peace among the nations; and in the sincerity of their participation in the memorial exercises we may find hope for the practical solution of the problem. Indeed the opening of the conference on disarmament was most auspicious, and is a fine augury for future international relations that will make unnecessary such sacrifices as our Unknown Warrior was called upon to make.

Armistice Day, 1921, was no ordinary holiday. No such auspicious conjunction of events has ever been known before. We believe it will mark the opening of an epoch of good will and friendship among nations and a period of prosperity and human happiness unparalleled in the history of the world.

Agricultural Support For the Chemical Industry

AT THE recent meeting of the Association of Official Agricultural Chemists a very significant resolution was adopted. It reads:

> Whereas, the research necessary for the solution of agricultural and other industrial problems can only be carried on with the aid of a firmly established chemical industry; and
>
> Whereas the development of chemical industry is one of the great factors tending toward the future welfare of our country, whether in times of peace or in times of war; it is therefore
>
> *Resolved*, That the Congress of the United States is hereby urged to continue adequate, beneficial legislation until the various chemical industries in the United States have become firmly established.

In the first paragraph, the reference to "agricultural and *other* industrial problems" emphasizes a fact which agricultural interests usually do not realize—that agriculture really is an industry. Furthermore this paragraph recognizes the close relationship of agricultural problems and chemical industry.

The tendency which our national legislators have recently exhibited of grouping themselves in various ways according to the nature of their constituency is in striking contrast to the tendency among the industries and the branches of technology. There is constantly increasing an appreciation of the mutual interests of the industries. We are coming more and more to realize that all industry demands the mining of coal, the movement of freight, the smelting of metals and the cutting of lumber on a basis of fair dealing both for the wage earners involved and for those who supply the invested capital. No one of our major industries can break down without immediately producing suffering to a greater or less degree among all others. It is a great mistake, therefore, to think of legislation intended to foster the interests of a single trade or class.

In no line of science or technology is this fact brought out more strongly than in the field of chemical industry. One man's final product is the next man's raw material. Unless the movement from natural resource to final commodity can go forward step by step with profit to each participant who really contributes to the industrial movement, we cannot expect most economical and satisfactory service to the final user. Co-operation of agricultural with manufacturing interests and manufacturing with transportation agencies can produce the best result. It will be well that every group recognize this fact and preach in support of the text which the agricultural chemists have so properly emphasized.

A Survey Of Special Libraries

THAT the special library is a valuable business asset has long been recognized by the engineering profession. Many of our industries too have come to realize that business policies are based most profitably on an accurate knowledge of facts, especially the sort of facts that are available in the technical books and current literature of the industry.

An idea of the extent to which American business is relying on its special libraries can be gained from the report of a survey recently completed by the Special Libraries Association and to which reference is made on page 909 of this issue. Of 1,300 special libraries included in this survey, 95 were collections of specialized information on industry and manufacturing, 66 were engineering libraries, 32 were chemical, 11 were mining and many of the remainder gave considerable attention to these subjects. It is interesting to note that three other classes—namely, business, banking and finance—showed a total of 142 sources of special information. Perhaps as the control of our larger industries is gradually passing into the hands of the banker and capitalist, these men are beginning to feel the need for scientific and technical knowledge. If these men are to guide our industries, it is obvious that they must be-

come to some degree familiar with their technology in order to be able to look beyond balance sheets to plant processes, yields, equipment, and research. Other financiers, who are less directly connected with industry, are called on to furnish advice on investments, and to do this intelligently they should have a readily available source of technical information.

The important rôle of the library in the program for the elimination of industrial waste has recently been brought to our attention by K. C. WALKER of the Bureau of Mines at Pittsburgh. His letter, which we are glad to print on another page of this issue, shows clearly that the special library is an important element in saving or preventing waste in our industrial world.

There are many other ways in which the special library demonstrates its value to industry. Not long ago one of our contemporaries cited an instance of a Western steel company that spent $10,000 on a special research problem. When the librarian of the company heard of the result, he sent a book from his shelves to the president, referring him to a complete solution of the problem which had appeared several years before in a well-known technical book. Such an occurrence is unusual, to be sure, but it serves to emphasize the importance of utilizing the experience of others and beginning research with a survey of existing knowledge.

HERBERT HOOVER has aptly stated the *raison d'être* of the special library in the following words: "The function of the business library, as I understand it, is to collect and to preserve data of value to the business executives and so to organize this information that it will be available for use with a minimum of delay. There can be no question of the value of such service to the larger business firms when the work is properly organized and the librarian in charge has a clear conception of the possibilities of his position. The librarian who can make his service an integral part of his firm's organization may become a positive factor, both in the increase of profit and in the development of constructive business standards."

Deterrents for Methanol Consumption

HEADLINES in daily newspapers continue to announce deaths or blindness resulting from the error of drinking some decoction said to be whisky. Each account lays the blame to "wood alcohol" (not methanol, mark you, plain "wood alcohol"). A recent meeting of the Pennsylvania Medical Society spent a day listening to addresses on the diagnosis and treatment of methanol poisoning and to information on the number of cases which occur. In view of the very great amount of human damage being done, the physicians decided upon steps to educate the general public on the poisonous qualities of relatively small amounts of methanol, so that eventually a law could be passed absolutely forbidding its manufacture. Meantime they demanded that any package or substance containing methanol be marked "Poison" conspicuously, and a special revenue tax be assessed to bring the price up to and beyond that of denatured industrial alcohol.

Now all chemists will readily admit that doctors of medicine do not know a great deal about chemistry and the chemical industry, and what they do know is largely wrong. Otherwise they would know that methanol already costs twice as much as denatured ethyl alcohol, and they would remember that their indispensable formaldehyde all comes by way of methanol.

But that does not alter the fact that doctors have a deal more influence in public affairs than the chemists. In fact, if the medical fraternity were to unite on a movement to ban "wood alcohol," no matter how mistaken such a move would be, it would be a safe bet that the chemists could not save "methanol." Pleas based on the commercial importance of the substance would be as unavailing as was the specter of idle breweries to halt the Volstead act.

Theoretically, the first step toward the prevention of continued methanol poisoning would be to discover whether its source was commercial methanol or industrial alcohol denatured by the other and retailed for "anti-freeze" liquids and such like. But bootleggers are notoriously hard to catch, and once caught, do not divulge many of the tricks of the trade. However, since the trade itself is wholly unscrupulous and one for profit, it is to be presumed that the "kick" which is mixed into their wares is the cheapest alcohol they can get, and no qualms are felt as to whether the stuff is made unfit for human consumption (that is, denatured) by a liquid which is actually a deadly poison, and is so marked on the original container. Let the thirsty buyer beware!

In order to protect this weakling, all alcohol whose point of consumption is doubtful must contain a small amount of some substance which would not unfit the distillate for legitimate industrial uses but which, when diluted to a potable degree, would unmistakably make its presence known by a revolting color, taste or odor. TUNISON has listed a number of denaturants; would not some of the intensely bitter alkaloids do the trick? OUTERBRIDGE has already informed the chemical fraternity of a simple addition (7 mg. fluoresceine per 100 c.c.) which has effectually protected large warehouse stocks of ethyl alcohol from pilferage for many years. Dilution with water to potable proof causes a yellowish green fluorescence, reminding even the most hardened sinner of the hell-fire in store for him if he stomachs it.

Other more effective deterrents may already be known, or doubtless can be found, if those now available are so expensive as to prevent their use. Their action, even their presence, does not need to be widely advertised, and the burden should be on the shoulders of the purchaser to prove that they unfit the alcohol for legitimate use.

A stitch in time saves nine!

The Dunce And the Devil

SOME day, when we are all settled down in ease and comfort and we feel like it and haven't any pressing obligations to bother us, we plan to write an allegory about the *Dunce* and the *Devil*. The problem is to accomplish the utter ruin of something or somebody good, like *Christian* in "Pilgrim's Progress," in which the *Devil* will be foiled in his wicked wiles because the *Dunce*, in his effort to save the hero, will beat the *Devil* to his own goal.

We have said it before and we repeat it without fear of contradiction, that every one of us is, in one respect or another, feeble-minded. Some of us can't mend a clock, others can't keep accounts, others can't saw a board straight or play poker or golf or sell goods or write poetry or sense relativity or do any one or more of thousands of things that many men do well. So, in respect to his inhibitions, each of us is a dunce. Apart from these inhibitions we may be men of signal in-

telligence. Like the genius, the dunce is a specialist in his line; but unlike the genius, he is usually unaware of this fact. You don't have to look like a dunce, or even to act like one, to be one.

The other day we heard of a man who made a remarkable success with his department store. He knew how to sell smocks and frocks and gowns and yarns and needles and pins and bonnets and laces and fur coats and silk stockings and all sorts of things to women. He knew how to advertise, when to have bargain sales, when to mark up and when to mark down; in short he was so successful a merchant that he retired in affluence when a comparatively young man. He tried the rest cure in California, but he was a little young for the long sleep and it got on his nerves; so he returned to the home town to be a bank director and a leading citizen.

Under the auspices of a leading firm of dealers in securities there took place a consolidation of a number of manufacturing concerns making paper. Local subscribers took a large block of the new stock and bonds and the bankers saw to it that some effective window-dressing was done in the personnel of the new organization. The returned Leading Citizen was made vice-president in charge of sales, and since every local stockholder and bondholder and his wife had bought things from him, all knew him to be a great merchant who was a master of sales. Everything went well until the slump in the market came along, and then the troubles began. He did not know the uses of paper or who made this or who bought that or how to hustle out and grab what was left of a market or how to get people to use his company's products as measures of economy or advantage—in short, he was lost in his job. Old Uncle Bankruptcy used to croon his doleful song into his wakeful ear by night and the affable lawyer who was a friend of the judge and likely to be appointed receiver if things should go wrong began to make friendly calls by day to "get the hang of the business." Those were gloomy times!

Now the Leading Citizen was incompetent as a paper salesman, but otherwise he was a man of rare judgment and ability. He saw that they must sell their product and that he was not succeeding as well as others who knew the business. So he resigned and they called in a competent and informed man who took his place and saved the concern. The Leading Citizen was a man of character, because he did not let his own vanity stand in the way of saving the investments of his neighbors. There are not very many men who reach this modest height. The experience aged him so that he can now enjoy the climate and the quiet and calm among the other wuzzers under the orange trees along the Pacific shores. He set an excellent example.

An Old Fake Persists

"I love it, I love it, and who shall dare
To chide me for loving that old arm-chair?"
But closer and dearer by far is the name
Of the man that can teach me to beat any game!

THIS desire to beat any game is truly a blind passion. We want to get rich quick with such intensity that we haven't even the patience to listen to the voice of reason or of experience that tells us when the cards are stacked against us.

On February 2 last we published an article on "Easy Money From Peat"; and "CHARLIE," the assistant and secretary of the corporation, wrote to us after reading the article that we had been correct in our diagnosis of the thing as a fraud; that he had lately discovered the fact that the gasoline and methanol had been put into their respective containers before "the professor" had charged his retort with peat or begun to "make" the gasoline. CHARLIE wrote to us that he had resigned on discovering this fact, and we published his letter in our March 23 issue.

On May 24 LOUIS ENRICHT, "the professor," was arrested for practicing fraud, and was released on $1,000 bail. He is still at large.

On June 8 we published another letter advising us that we had saved, by our exposure, the funds of a number of prospective investors.

Later the New York *World* published in one of its editions a record of "Gasoline From Peat," setting forth ENRICHT as a gifted inventor and, from reading the article, it appeared as though he were offering a pretty good thing. We sent a reprint of "Easy Money From Peat" to the editor of the New York *World*, but received no reply. We have failed to observe a retraction of the misleading article, but it may have appeared. Now comes the *Evening Telegram* of September 23, which tells us that LOUIS ENRICHT, the seventy-nine-year-old president of the Enricht Gasoline Corporation, has been "demonstrating" again, this time at Seaford, L. I. It was the same old game of putting peat into the same apparatus that we depicted in our report; the peat body was "ignited and reduced to vapor," then forced through a "condenser," which transmogrified some of the gas into methanol, then through a "compressor" and past a catalyzer, etc., until presto! there was the gasoline! We told all about it, even to how the gasoline leaked out of the back end of the apparatus before the peat was put into the front end, and how the whole thing was a palpable fraud. Did it make any impression? Not beyond our own circle of readers, apparently. Here is the final paragraph of the news item in the *Evening Telegram:* "There were twenty-five or more present when the peat in the retort was ignited and the fire started to blow the gas through the apparatus. [In the earlier demonstration this was accomplished by ENRICHT'S remarkable pump.] As far as any one of the observers could tell the thing worked flawlessly, for in a few moments gasoline began flowing from the cooling coil into a barrel, and bottles were filled for the spectators."

What was the matter with the eyes of those twenty-five or more observers? Were they all so credulous that when they saw gasoline coming out of a spigot they were convinced it had just been made? In the former demonstration which we reported a witness requested the old boy to repeat the operation after his gasoline tank had been displayed and the contents removed. He showed hot indignation that anyone should lack confidence in him. But of course he refused. Now we advise our neighbor the *Evening Telegram* that it has been advertising in its news columns a rank fraud; that ENRICHT has a bad record, and has been in this and similar games for years; that if the reporter had opened up the apparatus he would have found all the gasoline and methanol that came out safely stored there before the operation began, and that the sole beneficiary of money invested in ENRICHT'S scheme is ENRICHT himself, and not the investor.

Will the *Evening Telegram* tell these facts to its readers for their benefit? It should. But will it?

Readers' Views and Comments

Regarding Solvent Recovery Process

To the Editor of Chemical & Metallurgical Engineering

SIR:—Our attention has been drawn to a letter signed by James C. Lawrence entitled "Recovery of Volatile Solvents by the Bregeat Process" and published on page 93 of your issue of July 20, 1921. In this he speaks of "my own firm of Blair, Campbell & McLean, Ltd., Glasgow, Scotland." We desire to inform you that Mr. Lawrence is not a member of the firm of Blair, Campbell & McLean, Ltd., has no connection with it and is not authorized to use the name of that firm for any purpose. We desire further to inform you that although the American Chemical & Sugar Machinery Co., which Mr. Lawrence refers to as "the American offshoot of Blair, Campbell & McLean, Ltd.," was authorized for a time to act as the American agent of Blair, Campbell & McLean, Ltd., it now has no connection whatever with the latter firm.

Glasgow, Scotland. BLAIR, CAMPBELL & MCLEAN, LTD.

To the Editor of Chemical & Metallurgical Engineering

SIR:—With reference to the communication from Blair, Campbell & McLean, Ltd., of Glasgow, Scotland, I would advise that the holdings of that company in the American Chemical & Sugar Machinery Co., of Philadelphia, have been acquired by the undersigned, and that the latter firm continues to manufacture its full line of equipment in its new works at Chester, Pa., now unhampered by territorial or agency agreements with Blair, Campbell & McLean, Ltd., of any nature.

Chester, Pa. JAMES C. LAWRENCE.

Rôle of Libraries in Elimination of Waste

To the Editor of Chemical & Metallurgical Engineering

SIR:—I was greatly impressed by the array of special articles appearing in your issue of Aug. 31, 1921. It would seem as though every corner of our industrial house had been searched for ways and means of preventing waste, but no person seems to have written anything on one important phase of the waste question. I refer to the very important part the so-called special library plays in the elimination of waste.

In the first place, what does a special library do for an industrial organization? It acts as a clearing house of printed information for the field in which the organization is at work. We know what the ordinary banking clearing house has done for the banks of this country. It has opened the way for a quicker dispatch of the banks' business and thereby eliminated the *waste motion* incident to the old methods of banking.

The special library when properly supported and efficiently managed will accomplish savings throughout the entire fabric of any organization.

Andrew Carnegie has been often quoted as saying that his organization had wasted thousands of dollars by failing to find out what others had done along the same line before they experimented. Obviously it is cheaper to send experts to the library and spend a few days searching for records on a given subject than to go ahead blindly building expensive apparatus, employing many men and consuming expensive material only in the end to find the experiment a failure, the same as others before you. One large concern is known to have spent in the neighborhood of $50,000 on an experiment which resulted in failure. Yet records were available in the local public library showing that the experiment had been tried by someone else and failed.

Saving is preventing waste. If we can find ways and means for saving steps in an operation we are preventing the execution of wasteful operations. One chemist in a large Ohio manufacturing concern lost a train while in a large industrial city. In order that he might utilize the intervening time to best advantage he found the public library of that town and spent his time browsing about. The result of his browsing was the discovery of a process that had been tried elsewhere which saved his concern $300 in one operation.

Still another metallurgical concern that I know of was about to start an expensive experiment, but just before launching the experiment one of the workers saw some information in print, brought to his attention through the library, that led to the subsequent abandoning of the experiment with much saving.

Instances of this nature might be multiplied. There is no need of enlarging upon the saving effected by properly supported special libraries manned by trained workers. The trouble is that most industrialists who have tried to experiment with libraries have assigned the task of organizing and operating to stenographers and similar people totally unqualified.

The special library is the one important element in our industrial world that can save or prevent waste. When run efficiently it prevents waste before it can begin by focusing all the known information on a task or project.

K. C. WALKER,
Research Reference Assistant.
Bureau of Mines Experiment Station,
Pittsburgh, Pa.

De-gasifying Silver With Iron Block

To the Editor of Chemical & Metallurgical Engineering

SIR:—On page 457 of your Sept. 7 issue occurs the following sentence: "The practice of inserting a piece of iron into the metal bath of this furnace (the Ajax-Northrup High Frequency) would materially disturb the induction."

This remark is in an article on Electric Furnaces, by J. Herlenius. The matter of placing iron in electric furnaces for the purpose of absorbing gases is touched upon in an editorial article in the same issue, page 450. In view of the prominence that you have given the matter, we think it proper to forward a statement which proves the incorrectness of the sentence quoted above. We wrote to Mr. Herlenius about it and he replied in part as follows:

"I regret the mistake made as referred to in your letter, but I took for granted that the iron would undoubtedly, on account of its lower electrical conductivity, materially disturb the induction. However, I appreciate the fact brought forth in your letter that the lines of force are absorbed by the graphite crucible."

We were certain of the truth of our contention, but wished to make, and then explain, a simple experiment which would make the facts clear to your readers.

Accordingly we placed a conducting graphite crucible in a large inductor coil, and then placed in the otherwise empty crucible a small can made of sheet iron. The crucible heated rapidly and attained a red heat within 15 or 20 minutes. The can, however, heated no faster than it would have heated simply by radiation from the walls of the crucible. It was possible to pick up the can with the fingers after the crucible was approaching red heat. Afterward the crucible was removed from the inductor coil and the can alone was placed centrally in the coil upon a stick of wood. When the high-frequency current was turned on the can became red hot almost immediately.

This experiment verifies the conclusions of theory that there are no free "lines of force" inside of the graphite crucible (provided this has good electrical conductivity and the wall is not too thin), and that therefore iron within the crucible would have no possible effect upon the induction. E. F. NORTHRUP.

Trenton, N. J. Vice-President and Technical Adviser Ajax Electrothermic Corporation.

Hardened Rosin and Resin Esters

To the Editor of Chemical & Metallurgical Engineering

SIR:—In the writer's article on "Hardened Rosin and Resin Esters," in your issue of Sept. 7, the statement was made on page 474 that "Gardner ('Papers on Paint and Varnish,' p. 234) used 55 lb. of glycerine to 100 lb. of rosin. . . ."

Referring to this, Dr. Gardner has advised me that the figure 55 in his book is a misprint, and should read 15 lb. He says further: "We have never used more than 25 per cent in our experiments, and have found that 12 to 15 per cent is sufficient, although more is frequently used in practice." A. MURRAY.

Springfield, Mass.

Variation of Hardness in Quenched Specimens

To the Editor of Chemical & Metallurgical Engineering

SIR:—On page 695 of the Oct. 12 issue of CHEMICAL & METALLURGICAL ENGINEERING an article by Carle R. Hayward seems to imply that the center of a heat-treated steel bar is necessarily harder than the edge. It is rather unfortunate that the conditions surrounding his experiments were such as to bring about this result, as the reverse effect is equally possible.

A paper by Honda, Matsushita and Idei presented at the May meeting of the Iron and Steel Institute, "On the Cause of Quenching Cracks," gives sufficient data to show that both effects are possible and outlines the conditions necessary for either result. These investigators conclude that:

(1) In a soft quenching, such as in oil from a temperature not exceeding 820 deg. C., the hardness of different specimens is greatest in the outer portion, and decreases from its periphery toward the center.
(2) In a medium quenching, such as that of a steel 0.9 per cent carbon at 780 deg. in water, or that of steel 1.47 per cent carbon at 900 deg. in oil, hardness is nearly constant everywhere.
(3) In a hard quenching, such as that of a steel containing more than 0.68 per cent carbon from 800 deg. C. or a higher temperature in water, the hardness is least in the outer portion and increases rapidly toward the center.

An examination of Hayward's data shows that all tests fall within group 3, where the hard center may be anticipated. Honda explains the phenomenon by his theory of quenching which assumes that the A_1 transformation is not a single but a compound transformation consisting of austenite $\rightleftarrows$ martensite $\rightleftarrows$ pearlite. In the case of hard quenching where the rate of cooling of the exterior parts through the transformation range is very rapid the last part of the transformation is completely arrested and the first change partly so. The central portions do not cool quite so rapidly and the transformation is nearly all to martensite. It is well known that austenite is softer than martensite. For a soft quenching the cooling in the outer portions is slow enough to permit the formation of martensite but not pearlite, while in the center much pearlite is formed, and for this condition the outside would be the harder.

It is also apparent that the size of specimen which also controls the rate of cooling would have an effect in determining whether the inner or outer portions of a quenched steel bar were the harder.

Physicist, Bureau of Standards, Washington, D. C. R. W. WOODWARD.

To the Editor of Chemical & Metallurgical Engineering

SIR:—Dr. Woodward's discussion of my article on "Hardness Variations in Heat-Treated Steel" is just what I hoped for. The data which I presented and more in my files show with scarcely an exception that round steel bars are harder at the center than at the outside. Any evidence to the contrary will be a contribution to our general knowledge of the subject. Unfortunately I have not at hand the paper by Honda, Matsushita and Idei quoted by Dr. Woodward and cannot adequately discuss their results. Their conclusions given in Dr. Woodward's communication refer apparently only to steels in the quenched condition, whereas most of my results were on steels reheated after quenching. Any theory of quenching hardness which involves the presence of austenite in the steel is of limited application, for it is doubtful if austenite is present in appreciable quantity unless a special steel is used or the cross-section rather small and the quenching is sudden. No austenite would be present in ordinary steel reheated after quenching. As noted by Dr. Woodward, the size of the specimen is very important. CARLE R. HAYWARD.

Mass. Inst. of Technology, Cambridge, Mass.

Non-Magnetic, Flame-, Acid- and Rust-Resisting Steel

To the Editor of Chemical & Metallurgical Engineering

SIR:—I have seen the article published in CHEMICAL & METALLURGICAL ENGINEERING for Oct. 26, 1921, page 797, on "Non-Magnetic, Flame-, Acid- and Rust-Resisting Steel," and have read the article with much interest.

I regret very much that a misstatement appears in the caption of the article: " . . . but after heat-treatment become hard and resistant to attack of all agencies." As a matter of fact, it requires no heat-treatment whatever to make the steel resistant to attack, and furthermore it is an error to say that it becomes hard after heat-treatment, as whatever hardness this steel has is natural to it. The only case in which we heat-treat the steel is in annealing for cold forming.

I should appreciate it if you would correct this statement that the steel "after heat-treatment becomes hard and resistant." To repeat, it requires no heat-treatment whatever to bring out its resistant qualities.

Crucible Steel Co. of America, Pittsburgh, Pa. C. M. JOHNSON, Director Research Dept.

Eugene Schneider, Fritz Medalist

A SCHNEIDER is nearly as well known as a Big Bertha to the doughboy and American newspaper reader. Schneider, the creator of Schneiders and 75's without number, is also known personally to many fortunate American metallurgists who met him during 1919, when he was with us, the president of the French Economic Mission to the United States. Then many honors were given him, chief among which were the Gold Medal of the Mining and Metallurgical Society of America, honorary membership in the American Iron and Steel Institute, the degree of Doctor of Science by the University of Pittsburgh, of Doctor of Science by Western Reserve University in the city of Cleveland and of Doctor of Engineering by Stevens Institute of Technology.

It was only fitting, therefore, that the American Engineering Societies should send their delegation from England to France to present him their most valued token of esteem, the John Fritz Medal.

EUGENE SCHNEIDER

Eugène Schneider, ironmaster, owner of the Schneider Works, Member of the Chamber of Deputies from 1898 to 1910, president of the British Iron and Steel Institute, 1918-1920, was born at Le Creusot, France, in 1868. He is the grandson of a Lorrainer Schneider (1805-1875), an ironmaster of Bazeilles, who at the beginning of the last century purchased the former royal foundry of Le Creusot, which was built in 1782 under the patronage of Louis XIV.

Eugène Schneider made an early start in business. In 1887, after finishing his studies and completing his military service, he began work for his father and was soon taken into partnership. In 1898, at the death of Henri Schneider, he became the head of the business and succeeded his father in the Chamber of Deputies.

Before the war the activities of the Schneider Works extended over various branches of the iron and steel industry, including mechanical and electrical engineering and shipbuilding. Moreover, Mr. Schneider had developed the manufacture of munitions—especially artillery—to a high point of perfection, a circumstance which was of tremendous value to France in 1914 when hostilities began.

Since the first, however, his aim has been to improve the institutions which his father founded. Especially has he been active in developing a fine spirit of endeavor and better understanding of the rules of life among his employees and has striven in every way possible to improve their material conditions of living. He has introduced the most modern safety appliances; he has organized advanced technical classes; extended the pension system inaugurated in 1877 long before national legislation touched this subject, provided medical inspection in the schools, established classes for instruction in domestic economy and made provisions for the care of orphans and of children who have lost one of their parents. The Schneider schools are regarded as models for the preparation of engineers, foremen and workers. Thanks to the encouragement which Mr. Schneider gave to the practice of thrift as well as to the loans he made, the workers in his factories have their own homes and gardens.

Production fell off in the Schneider Works with mobilization, but by the end of 1914, in spite of the shortage in labor and raw material, a tremendous effort was made to increase the production of steel, the construction of cannon of all calibers, gun carriages, shells, and all other materials necessary for national defense. The German invasion captured 81 per cent of the blast furnaces of France and 63 per cent of its steel-making capacity. Yet within 2½ years the number of blast furnaces was trebled and the number of open hearths had increased 60 per cent. Before the war was ended rifles were being produced at 290 times the former annual rate; machine guns 70-fold, 150-mm. shells 225-fold and 75-mm. shells 15-fold, the latter reaching the enormous number of 200,000 a day.

In all this Schneider's efforts were an important factor. No less than 250,000 men were employed by him at Le Creusot and his other steel works, shipyards, iron and coal mines, optical works, machine tool plants, electrical shops, Diesel engine works, locomotive works and bridge plants. This single organization supplied three-quarters of all the French artillery, including 21-in. guns, besides one-half the American heavy artillery, all its field guns and many hundreds of cannon to Belgian, Italian, Rumanian, Russian and Serbian armies. This effort spread to the countries of the Allies and particularly to America, where, in March, 1915, Mr. Schneider sent special engineers to introduce French methods of manufacturing steel for shells and cannon. When the official French mission arrived in the United States to purchase steel, it found its task greatly lightened by his work.

After the armistice the efficient organization of the Schneider Works was as rapidly as possible converted from a war basis to a peace footing, and already, in spite of the difficulties of the present-day situation, the construction of locomotives, tractors, turbines and electrical machinery of all sizes and powers has begun.

Importance of the Olefine Gases and Their Derivatives I—Sources and Uses of Ethylene and Propylene*

A Brief Review of Researches Which Have Formed the Foundation for an Olefine Gas Industry—Corresponding Alcohols and Artificially Prepared Gas Mixtures as Sources of Olefines—Properties and Applications of Ethylene and Propylene

BY GEORGE O. CURME, JR.

AS THE past two decades have witnessed the rapid rise of a new branch of the organic chemical industry, based on the conversion of acetylene into organic products of commercial importance, so there has also been a somewhat slower but an even more promising movement toward the construction of another new division of the industry through the utilization of the related and widely distributed hydrocarbons, ethylene and propylene.[1] In the case of acetylene, the period beginning with the initial discovery of Kutscheroff in 1881,[2] leading the way to acetaldehyde and all its derivatives, and that of Berthelot in 1869,[3] leading to the large variety of chlorinated products and extending to the commercial development of these basic processes, was relatively short, due in no small part to the epoch-making discovery of Willson[4] which gave the industrial world a bountiful supply of calcium carbide and pure gaseous acetylene. In the case of ethylene and propylene the start was made much earlier, but until the great war brought into sharp emphasis the vital necessity of large quantities of ethylene, in particular, the commercial development of the olefine gases was held back, and enjoyed only a scattered attention in disjointed applications. It may be truly said that today there is no co-ordinated large-scale industrial development of this field, but from many quarters there are coming signs of activity that indicate a growing realization of its commercial importance.[5] At the present writing a small plant is already in regular operation under the author's direction, and scattered products are offered on the market by other companies in the United States, and abroad, showing a need for ethylene and propylene products by the modern chemical industry.

EARLY STUDIES OF OLEFINE GASES

As early as 1795 the preparation of pure ethylene from the even earlier known ethyl alcohol was described by the four Dutch chemists Deimann, Troostwyk, Bondt and Louwrenburgh,[6] who also prepared the derivative, ethylene dichloride, in pure state at the same time, thus giving the name of olefiant gas (oil-forming) to the ethylene, which later has come to designate the whole series of homologous substances, the olefines. In 1826 Hennell,[7] working in Faraday's laboratory, produced ethyl hydrogen sulphate from ethylene and sulphuric acid and established its relationship to ethyl alcohol. This same discovery was reannounced by Berthelot in 1855[8] and was promptly capitalized by the Frenchman Cotelle,[9] who in 1862 organized a company to produce ethyl alcohol from the then known ethylene content of illuminating gas by absorption in sulphuric acid and subsequent hydrolysis to yield ethyl alcohol. This enterprise was never carried into large-scale operation, and Cotelle's motives were even cast under suspicion by certain of his contemporaries. Nevertheless it is very similar indeed to the proposal which is being discussed seriously today by British chemists and which is being carred out on a large experimental scale.

At only a slightly later date Berthelot[10] announced the absorption of propylene in suphuric acid, and, by a similar process to the above, the production of isopropyl alcohol. This process, too, lacked support at the time of its discovery, but has been revived without material modification within recent years.

Again in 1900 a German, P. Fritschke,[11] came to the United States to take advantage of our then rather unjust excise laws, requiring tax on alcohol used in making ether, and erected a plant in Richmond, Va. This plant operated until 1907, making commercial ether from the ethylene produced in the cracking of petroleum. Since that time the Germans, making use of their cheap potato spirits, developed a process in operation for several years at Bitterfeld for producing ethane gas from ethylene by hydrogenation.[12] This was used as a refrigerant to supplant carbon dioxide on account of its better vapor pressure characteristics. Also a rather extensive production of ethylene chlorhydrin from ethylene and bleaching powder was undertaken by certain of the German and Swiss dye companies for use in an improved indigo synthesis. This later was extended under war-time conditions to the manufacture of "mustard gas" in the German offensive gas warfare, as well as to the production of nitro ethylene glycol for use as a propellant. Also within this same period many

A contribution from the Mellon Institute of Industrial Research of the University of Pittsburgh. The writer wishes to acknowledge here his gratefulness to E. R. Weidlein and W. A. Hamor, of the Administration of the Institute, for their co-operative support and encouragement.

*This article, the first of a series of five, treats in a preliminary way of certain general phases of the researches conducted continuously by the writer over a period of seven years, since 1914, in the Mellon Institute of Industrial Research of the University of Pittsburgh. The processes developed now constitute the basis of the industrial operations of the Carbide & Carbon Chemicals Corporation's plant at Clendenin, W. Va.

[1]The purpose of this article is to outline in a general way the technical importance of the olefine gases, as demonstrated by the recorded literature and supported by the writer's own work. It is manifestly impossible to recognize in such a brief paper all the valuable contributions made by the many investigators in this field, and accordingly only a few of the most important are cited. The bibliographic citations referred to will supply the reader with the references necessarily here omitted.

[2]Kutscheroff, *Ber.*, vol. 14, p. 1540 (1881); vol. 17, p. 13 (1884).

[3]Berthelot and Jungfleisch, *Ann. Suppl.*, vol. 7, p. 252 (1869).

[4]Willson, U. S. Patent 492,377 (1893).

[5]Garner, *Am. Gas. Eng. J.*, vol. 108, pp. 489-95; 505-08 (1918). Brooks, CHEM. & MET. ENG., vol. 20, p. 629 (1920). Bacon and Hamor's "American Petroleum Industry," 1916, vol. 2, pp. 559 and 592. Ellis, "Gasoline and Other Motor Fuels," 1921, pp. 286,479,-560.

[6]Deimann, Troostwyk, Bondt and Louwrenburgh, *Crell's Ann.*, vol. 2, pp. 196,310 and 430 (1795).

[7]Hennell, *Phil. Trans.*, 1826, p. 240; 1828, p. 365.

[8]Berthelot, *Compt. rend.*, vol. 40, p. 102 (1855).

[9]Cotelle, *Wagners Jahresber.*, 1863, p. 593.

[10]Berthelot, *Ann. chim. phys.*, (3) vol. 43, p. 399 (1855).

[11]Fritschke, *Chem. Ind.*, vol. 35, p. 637 (1912). Baskerville and Hamor, *J. Ind. Eng. Chem.*, vol. 4, p. 214 (1914).

[12]Ger. Pats. 265,171 and 265,297, issued to Elektrochemische Verke. G.M.B.H.

German and other patents have appeared for producing ethylene from acetylene by partial hydrogenation. It has been stated that ethyl alcohol has been made from this ethylene,[13] although the more recent production of ethyl alcohol from acetylene through the intermediate formation of acetaldehyde has supplanted any efforts along this line.

Recent Developments

In this country the Commercial Research Co. carried on a rather extensive development of the production of ethylene and propylene chlorhydrins from the vapors of cracked petroleum products in the years 1912 to 1918,[14] but as far as known without commercial success. During the period of the war under Government subsidy a large number of private plants were equipped with ethylene from alcohol generation units, as well as the Government arsenals, and at the time of the armistice good progress was being made toward the goal of producing 200 tons per day of mustard gas by the ethylene-sulphur monochloride process.

Since 1918 many of the plants both here and abroad, equipped for ethylene production, have continued to operate on making certain chemical specialties from ethylene generated from alcohol. Also the production of isopropyl alcohol from the propylene of cracked petroleum vapors has been announced almost simultaneously both in Germany and in the United States. At present writing this product is being made by several companies by processes varying in no broad way from Berthelot's original process. The British Government, realizing the military necessity of a large ethylene supply, has fostered the development of an ethylene industry in that country, and as a result the industrial absorption of the ethylene contained in coke-oven gases by sulphuric acid has been carried out with apparent success by the Skinningrove Iron Works,[15] among other companies. To the credit of these present-day chemists who are now developing these products commercially, it must be freely granted that they have indeed contributed greatly along technical and engineering lines to make their processes succeed where earlier efforts failed. To them, second only to the early pioneers, is due full credit for the success of these adventures.

Reactivity of Olefine Gases

During this extended period of more than 125 years the chemists of the world have not been inattentive to the interesting possibilities offered by the reactivity of the olefine gases, but on the contrary have carried on series after series of brilliant researches in this field which constitute today one of the most fascinating chapters of organic chemistry. It is beyond the scope of this paper to attempt to review this mass of accumulated knowledge which is already available in so many places and which has already been summarized excellently by others.[16] That the technical development has not kept pace with the promise given by the unselfish work of the early path-makers is perhaps unfortunate, but with a competent start now well made it holds much in prospect for the coming years.

The sources of crude material from which the olefine gases may be isolated are indeed quite widely distributed. These gases do not occur naturally, but their occurrence in artificially prepared mixtures has been generally known for many years due to the activity of many private research organizations as well as the Government bureaus which have published the analyses of gaseous mixtures from many sources. The easiest and most reliable source of the individual olefines is from the corresponding alcohol as has been referred to above, from which the gases may be obtained respectively in a pure state. This is best accomplished by passing the vapors of the alcohol over a suitable catalyst such as kaolin, with or without steam, at a temperature varying from 350 to 600 deg. C., according to conditions.[17] This fact has been common laboratory knowledge for many years, and it was to the pure ethyl alcohol that the Government turned in time of emergency, when the prompt production of large quantities of pure ethylene became a matter of national necessity. Denatured ethyl alcohol is universally obtainable, and while the propyl and isopropyl alcohols have hitherto been less accessible, it appears that they will from now on be much better known. Still other ethyl and propyl compounds, such as the chlorides, acetates, etc., will also yield the corresponding olefine gas by a similar reaction to the above, but as these compounds are all commercially derived from the alcohol, their industrial importance as a source of the gases is but secondary.

Occurrence in Artificial Gaseous Mixtures

A much more widely distributed source of these hydrocarbons exists in the gaseous mixtures obtained from the pyrolysis of organic matter. This includes coke-oven gas from the coking of coal, illuminating gas prepared from high-temperature decomposition of either oil or coal or both, the gases from the cracking of petroleum oils, the gases from the distillation of hardwood, oil shale, rosin, lignite, peat and many other materials of similar nature, which are now commonly treated for purposes other than the production of the olefine-containing gas mixtures. To a lesser extent there is also a certain olefine content in producer gas and blast-furnace gas. As will be readily recognized, this list includes practically all of the sources of artificial gas, and almost without exception these gases are used exclusively for the generation of power, heat or illumination. The olefine gases in these mixtures usually occur together with a variety of saturated hydrocarbons, hydrogen, nitrogen, carbon dioxide, carbon monoxide, aromatics and other higher olefines, commonly liquid when in the pure state. In some cases, as with the gases from the high temperature cracking of oils, the combined ethylene and propylene content may run as high as 35 to 45 per cent by gaseous volume under the most favorable conditions. In the more usual cases the combined olefine gas content is under 10 per cent and in most of the largest scale sources, such as coke-oven gas, a true olefine gas content of from 2 to 4 per cent is common. In the producer gas and blast-furnace gas it rarely exceeds a few tenths of a per cent. In all of the above-mentioned cases, the olefine content being an inconsiderable item at present in the operation of the processes concerned, the variations in analysis are rather wide, and no single analysis is of particular value.

In any particular case the problem of absorbing the desired olefine gases by chemical processes or that of

[13] J. Garcon, *Bull. soc. encour. ind. nat.*, vol. 127, p. 568 (1917). *Oil Paint and Drug Rep.*, vol. 91, p. 72 (1917).

[14] U. S. Pats. 1,253,615, 1,253,616, 1,253,617, 1,264,535, 1,295,339 and 1,315,229.

[15] C. F. Tidman, *J. Soc. Chem. Ind.*, vol. 40, p. 80 (1921).

[16] Meldola, "Chemical Synthesis of Vital Products," London, 1904. Malisoff and Egloff, *J. Phys. Chem.*, vol. 23, p. 65 (1919). Bacon and Hamor, *lib. cit.* Hamor, CHEM. & MET. ENG., vol. 23, pp. 425-34 (1920).

[17] Dorsey, *J. Ind. Eng. Chem.*, vol. 11, p. 288 (1919).

isolating them in the pure state is a special one for the material at hand. In the limited amount of past work on this subject the general procedure of finding a specific absorbent, such as sulphuric acid, or of using a specific reagent, such as chlorine, to form a condensible reaction product has found preference when handling such gaseous mixtures. On the other hand, a distinct advantage lies in having a pure gaseous material to deal with when carrying out chemical reactions. The former general process has the advantage of low costs, and for certain purposes at least the availability of the pure olefines from the alcohols successfully avoids the necessity of purifying the gases from the complex mixtures in which they occur. In the writer's work a novel process of producing the olefine gases is in use. Patents are now pending on the processes involved.

For use as such in the pure state when conveniently supplied to the market in compressed or liquefied form, as is common today with other industrial gases, it seems probable that both ethylene and propylene will find extensive application. These gases have physical properties as shown by the accompanying table.

PROPERTIES OF ETHYLENE AND PROPYLENE

	Ethylene		Propylene	
Gas density (air = 1)	0.976	(a)	1.498	(h)
Boiling point, 760 mm	—103.9 deg. C.	(b)	—47.8 deg. C.	(i)
Critical temperature	+9.9 deg. C.	(c)	+92.1 deg. C.	(e)
Critical pressure, in atmospheres	50.8	(d)	.....	
Density of liquid at b.p. (water at 40 deg. C. = 1)	0.570	(e)	0.610	(e)
Density of liquid near crit. temp. (at 6.2 deg. C.); (water at 4 deg. C. = 1)	0.306	(f)	.....	
Heat of combustion B.t.u. per cu.ft. (high)	1,591	(g)	2.356	(g)
Heat of combustion B.t.u. per lb. (high)	21,404	(g)	21,091	(g)
Heat of formation B.t.u., per lb.	—211	(g)	+92.6	(g)

(a) Stahrfoss, *Arch. sci. phys. nat.*, (4), vol. 28, p. 384 (1909).
(b) Burrell and Robertson, *J. Am. Chem. Soc.*, vol. 37, p. 1893 (1915).
(c) Maass and Wright, *J. Am. Chem. Soc.*, vol. 43, p. 1098 (1921).
(d) Cardoso, Arni and Bell, *Arch. sci. phys. nat.*, (4), vol. 30, p. 432 (1910).
(e) Maass and Wright, *loc. cit.* Calculated value.
(f) Cailletet and Mathias, *Compt. rend.*, vol. 102, p. 1206 (1886). Calculated value.
(g) J. Thompson, *Z. Phys. Chem.*, vol. 52, p. 346 (1905). Calculated value.
(h) Berthelot, Landolt and Bornstein, (1912), p. 150.
(i) Burrell and Robertson, Bureau of Mines Tech. Paper 142, p. 16.

The values given are believed to be reliable, although certain ones may be subject to slight revision.

Industrial Utilization

It may be readily seen that gases with these characteristics will find application in many ways. It is not expected that any hydrocarbon gas can rival acetylene, which possesses its unusual properties as a direct result of its highly endothermic nature. On the other hand, the olefine gases possess high fuel value, and for cutting and light welding may be expected to find favor in view of their easier transportation. It has also long been well known that illuminating gases owe their illuminating power largely to their olefine contents. The supply of these "illuminants" in pure form may now be expected to prove of value in special cases of illumination and heating, such as in country homes and the like. Furthermore in earlier scientific work seeking low temperatures ethylene has already been used as a refrigerant.[18] The similarity of propylene in its boiling point to anhydrous ammonia would suggest its possible use as a refrigerant, for refrigeration at temperatures nearer normal.

More important than the direct use of the olefine gases for themselves is the pronounced chemical reactivity which characterizes them. The chemical literature contains actual accounts of hundreds of reactions which may be carried out involving ethylene and propylene. It is unnecessary to state that all of these do not lead to commercially valuable products, but certain of them do show a means of building up from these materials substances which rank among the most important of the commercial chemicals. In addition to denatured alcohol, isopropyl alcohol, ethyl ether, ethylene chlorhydrin, ethylene glycol, ethylene dichloride and "mustard gas," which have already been mentioned above, there may be added diethyl sulphate, ethylene oxide, oxalic acid, formaldehyde, formic acid, acetone, propylene glycol, propylene chlorhydrin and many others, in addition to the simple combinations and derivatives of the above products themselves. It will be the purpose of following articles to describe certain of these new commercial products which perhaps are still not familiar to the chemical public, and to point out how these new materials may find their way into our rising American organic chemical industry.

Our national resources, which supply the greater part of our needs so amply from home, are also equally able to provide for an extensive ethylene and propylene industry. Consequently since modern military developments have shown that in addition to the toxic gases, acetone, alcohol, ether and such organic chemicals are also indispensable to national defense, therefore the olefine gas utilization, as soon as commercially developed, will find itself elevated to the position of one of the key industries to our modern commercial chemistry.

(Part II, on Diethyl Sulphate, will be published in a subsequent issue.)

[18] K. Onnes, *Z. komprimierte flüssige Gase Pressluft-Ind. A*, vol. 1, p. 169 (1898). Comm. Phy. Lab. Leyden No. 51 (1899).

A Survey of Library Service to Engineers

That the engineering profession has taken a leading position in the development of research and informational facilities is one of the facts disclosed by a recent survey made by the Special Libraries Association. As a result of this investigation more than 1,300 special libraries were discovered, many of which are largely concerned with engineering, technology, electricity, chemistry and industrial management.

Engineering libraries of various types are maintained by national and local engineering societies, by colleges and universities, by large manufacturing companies, by professional engineering firms, by public utility companies and by various other agencies. Some of these libraries have been in existence for many years, but many others have only recently been established. The most complete and comprehensive collection is that of the Engineering Societies Library in New York City.

Some of the engineering libraries report interesting special features. For example, the Boston Society of Engineers has a collection of books "written by engineers on subjects other than engineering." The library of a professional engineering firm reports a collection of from 100,000 to 200,000 trade catalogs covering a wide range of industries. One university library possesses 4,200 lantern slides on engineering subjects. Many of the engineering libraries have given special attention during the last few years to the collection of military, naval and aviation engineering literature.

The complete findings of the Special Libraries Association's survey have recently been published in the form of a "Special Libraries Directory," edited by Dorsey W. Hyde, Jr., president of the association, Mills Building, Washington, D. C.

Impact Properties of Various Steels

Cylinders of Steel, Centrifugal Cast, Were Sectioned and Tested—A Set of Steel Bars, With Increasing Carbon Content, and Some Steel Castings Were Tested After Various Heat-Treatments—A Comparison of Impact for Forged and Cast Steels

By F. C. LANGENBERG
Metallurgist, Watertown Arsenal, Watertown, Mass.

THE author of this article recently presented the results of certain investigations on the shock value of steel castings to the American Society for Testing Materials.[1] Requests for additional observations on the same subject have since been received, and the writer has therefore considered that the following further account of these and other investigations may be of general interest.

In the previous article results of tests were given showing the effect of phosphorus on cast steel made in the converter, the effect of different carbon and manganese contents on cast steel made in a small basic electric furnace, the effect of various heat-tratments on cast steel made in the acid open-hearth furnace, and results of impact tests made on forged steels of different carbon content and submitted to various heat-treatments.

Results are now given of an investigation of steel castings made by the centrifugal process, the effect of certain heat-treatments on cast steel, further details on the effect of heat-treatment on forged steels of different carbon content and a comparative summary of the impact strength of the various steels considered.

Three cylinders were received, each approximately 71½ in. long and 10.9 in. in diameter. The three castings were numbered 1, 2 and 3, respectively.

[1]Noted in CHEM & MET. ENG., vol. 24, p. 1146, June 29, 1921.

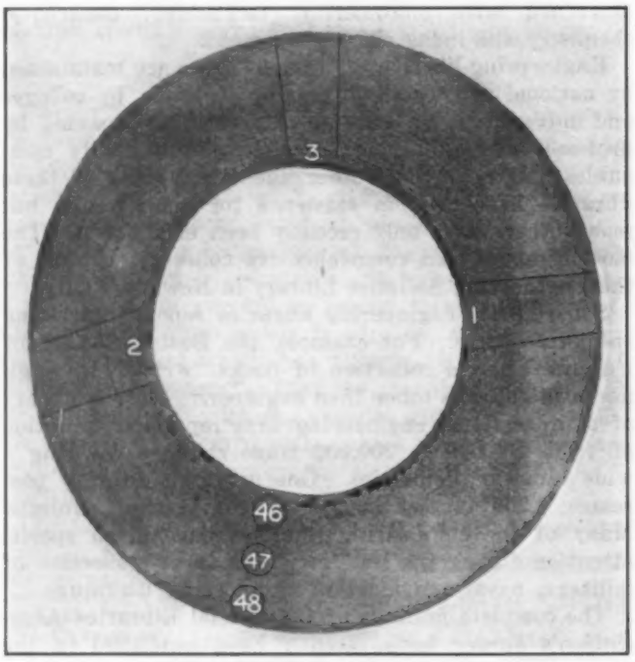


FIG. 1. MACROSTRUCTURE OF CYLINDER 34. × ½. ETCHED WITH IODINE

Castings No. 1 and No. 3 were then annealed at 950 deg. C. for 4 hours, air-chilled, and drawn 6 hours at 600 deg. C. After the completion of the anneal, casting No. 3 was cross-cut into sections lettered from *A* to *J*, and casting No. 1 was split longitudinally.

TABLE I. CHEMICAL ANALYSES

Sample	Position in Section	% C	% Mn	% Si	% S	% P	% Ni	% Cr	% Cu
	Sample from Casting No. 3, Section A								
46	Near inside	0.484	0.63	0.196	0.018	0.023	2.83	None	0.040
47	Middle	0.370	0.57	0.179	0.021	0.015	2.80	None	0.045
48	Near outside	0.370	0.53	0.179	0.021	0.017	2.71	None	0.045
	Sample from Casting No. 3, Section H								
52	Near inside	0.384	0.53	0.188	0.019	0.015	2.76	None	0.045
53	Middle	0.354	0.55	0.179	0.019	0.015	2.70	None	0.038
54	Near outside	0.372	0.54	0.179	0.021	0.016	2.72	None	0.043
	Sample from Casting No. 1, Taken 6 in. from Reference Point								
83	Near inside	0.454	0.43	0.484	0.014	0.018	2.29	None	0.064
84	Near outside	0.430	0.43	0.470	0.017	0.015	2.30	None	0.060
	Sample from Casting No. 1, Taken 32½ in. from Reference Point								
85	Near inside	0.482	0.46	0.484	0.020	0.026	2.30	None	0.035
86	Near outside	0.450	0.45	0.466	0.019	0.022	2.30	None	0.040

TABLE II. TENSILE AND CHARPY IMPACT TESTS

Treatment: Annealed 4 hours at 950 deg. C., air-chilled, drawn 6 hours at 600 deg. C.

Specimen No.	Yield Point (Lb. per Sq. In.)	Tensile Strength (Lb. per Sq. In.)	Elongation (per Cent)	Contraction (per Cent)	Brinell Hardness	Charpy Impact Tests — Specimen No.	Ft.-Lb.	Average Ft.-Lb.	Grand Ave.
	Physical Tests on Casting No. 3, Ring C—Transverse								
10	48,500	82,500	19.0	24.0	159	22	11.48	10.74	12.80
						23	10.01		
11	49,500	83,500	21.5	30.7	171	24	11.71	14.86	
						25	17.92		
	Physical Tests on Casting No. 3, Ring C—Longitudinal								
12	49,000	79,000	20.5	30.7	156	26	16.14	17.57	17.74
						27	19.01		
13	49,000	83,000	17.5	27.4	167	28	16.60	17.92	
						29	19.24		
	Physical Tests on Casting No. 3, Ring G—Transverse								
14	47,500	79,000	22.0	34.0	149	30	12.95	14.85	14.23
						31	16.76		
15	49,000	79,000	23.5	27.4	159	32	13.58	13.61	
						33	13.65		
	Physical Tests on Casting No. 3, Ring G—Longitudinal								
16	49,500	84,000	18.5	20.5	171	34	16.60	16.95	16.05
						35	17.30		
17	49,500	77,000	*9.0	16.9	159	36	13.96	15.16	
						37	16.37		
	Physical Tests Taken on Casting No. 1, 6 in. from Reference Point—Tangential								
59	55,000	92,500	14.5	16.9	171	69	4.65	4.80	4.61
						70	4.96		
60	56,500	93,500	11.5	13.3	175	71	5.89	4.41	
						72	2.94		
	Physical Tests Taken on Casting No. 1, 6 in. from Reference Point—Longitudinal								
61	56,000	92,500	13.5	9.5	171	73	5.82	5.31	5.31
						74	4.81		
	Physical Tests Taken on Casting No. 1, 32½ in. from Reference Point—Tangential								
63	56,000	92,000	10.0	13.3	179	75	7.21	5.85	5.39
						76	4.50		
64	55,500	94,000	12.5	13.3	175	77	4.96	4.92	
						78	4.89		
	Physical Tests Taken on Casting No. 1, 32½ in. from Reference Point—Longitudinal								
65	57,000	94,500	10.5	16.9	171	..	.....	.....	.....

* Rejected from average.

The sections from castings lettered from *A* to *J*, inclusive, were then polished and etched with iodine. One-half of casting No. 1 was polished throughout its entire length and also etched with iodine. The result of the etching of a ring from casting No. 3 (Fig. 1) shows the existence of circumferential bands and also the persistence of the original ingot structure. The bands proved to be ferrite by microscopical examination.

Rings *B* and *F* from casting No. 3 were rough-machined on the interior and then forged to a wall-thickness of 1¼ in. The length of the ring was not increased by this operation, the decrease in the diameter of the cylinder wall being made by an increase in the diameter of the ring. Fig. 2 shows the location of the samples taken from rings *B* and *F* in the forged condition and the physical tests obtained are given in Table III.

TABLE III. TESTS ON CASTING NO. 3, ROUGH-MACHINED AND FORGED. LOCATION OF SAMPLES IN FIG. 2

Specimen No.	Yield Point (Lb. per Sq. In.)	Tensile Strength (Lb. per Sq. In.)	Elongation (per Cent)	Contraction (per Cent)	Brinell Hardness	Charpy Impact Tests — Specimen No.	Ft.-Lb.	Ave. Ft.-Lb.	Grand Ave.
Physical Tests on Casting No. 3, Ring B—Transverse									
89	55,000	94,500	22.5	40.3	192	97	19.40	20.37	19.88
						98	21.34		
90	57,500	97,000	23.5	43.3	167	99	18.15	19.39	
						100	20.64		
Physical Tests on Casting No. 3, Ring B—Longitudinal									
91	57,500	92,000	23.5	51.9	192	101	19.40	19.16	19.95
						102	18.93		
92	52,500	91,500	25.0	49.1	187	103	22.03	20.75	
						104	19.47		
Physical Tests on Casting No. 3, Ring F—Transverse									
93	53,000	91,000	20.5	46.2	187	105	21.41	21.49	22.05
						106	21.57		
94	54,500	94,000	20.5	49.1	202	107	20.71	22.61	
						108	24.52		
Physical Tests on Casting No. 3, Ring F—Longitudinal									
95	54,000	96,000	22.5	49.1	179	109	16.76	17.96	18.54
						110	19.16		
96	53,500	98,000	23.5	49.1	197	111	20.56	19.12	
						112	17.69		

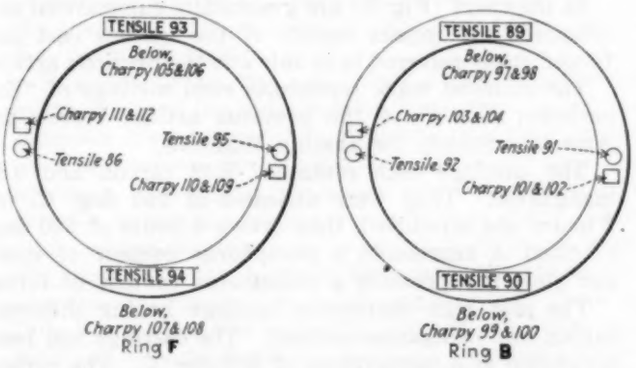


FIG. 2. LOCATION OF SPECIMENS LISTED IN TABLE III

Sections of forged ring *F* were then heat-treated as follows: Heated to 800 deg. C. and held for 1 hour, after which they were quenched in water. Subsequent to the quenching operation they were drawn at 675 deg. C. The sections of cast ring *G* were similarly heat-treated. The location of the test specimens taken from the sections so treated are shown in the drawing, Fig. 3. There is thus available for comparison tensile and Charpy tests from two rings, ring *F* being forged and heat-treated and ring *G* being treated without forging. The physical tests resulting are shown on Table IV. The forged and heat-treated ring shows better ductility than the cast and heat-treated ring, although the ductility was exceptionally good for both specimens, as was likewise the Charpy value. The Charpy values obtained upon the heat-treated casting are superior to those generally obtained upon gun forgings. This statement

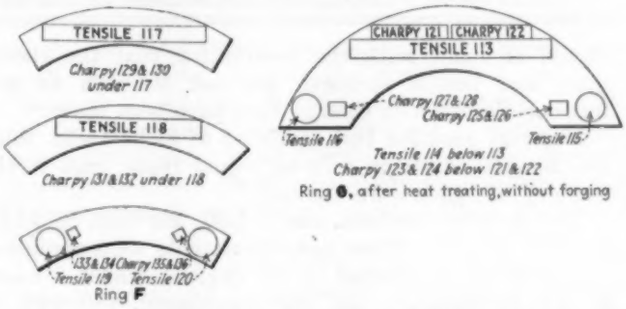


FIG. 3. LOCATION OF SPECIMENS LISTED IN TABLE IV

TABLE IV. TESTS ON CASTING NO. 3 LOCATION OF SAMPLES IN FIG. 4

Specimen No.	Yield Point (Lb. per Sq. In.)	Tensile Strength (Lb. per Sq. In.)	Elongation (per Cent)	Contraction (per Cent)	Brinell Hardness	Charpy Impact Tests — Specimen No.	Ft.-Lb.	Ave. Ft.-Lb.	Grand Ave.
Physical Tests on Casting No. 3, Ring F¹—Tangential (Forged and Heat-Treated)									
117	61,500	88,000	25.5	67.0	187	129	32.43	31.42	31.50
						130	30.41		
118	67,000	89,500	25.5	62.3	187	131	32.59	31.58	
						132	30.57		
Physical Tests on Casting No. 3, Ring F¹—Longitudinal (Forged and Heat-Treated)									
119	65,000	92,000	25.0	62.3	179	133	24.05	24.51	25.38
						134	24.98		
120	64,500	91,000	27.5	69.2	179	135	24.98	26.26	
						136	27.54		
Physical Tests on Casting No. 3, Ring G¹—Tangential (Heat-Treated Casting)									
113	62,500	89,500	24.0	54.6	163	121	25.60	23.97	21.56
						122	22.34		
114	54,500	79,000	24.5	43.3	159	123	19.16	19.16	
						124	19.16		
Physical Tests on Casting No. 3, Ring G¹—Longitudinal (Heat-Treated Casting)									
115	66,500	91,000	24.5	54.6	183	125	17.84	19.16	19.88
			25.0			126	20.48		
116	67,000	92,000		51.9	179	127	18.70	20.44	
						128	22.19		

TABLE V. SUMMARY OF PHYSICAL TESTS ON CENTRIFUGAL CASTINGS

Specimen Used	Treatment	Yield Point — Tangential Specimen (Lb. per Sq. In.)	Yield Point — Longitudinal Specimen (Lb. per Sq. In.)	Tensile Strength — Tangential Specimen (Lb. per Sq. In.)	Tensile Strength — Longitudinal Specimen (Lb. per Sq. In.)	Per Cent Elongation — Tangential Specimen	Per Cent Elongation — Longitudinal Specimen	Per Cent Contraction — Tangential Specimen	Per Cent Contraction — Longitudinal Specimen	Charpy — Tangential Specimen, Ft.-Lb.	Marked on Fig 5	Charpy — Longitudinal Specimen, Ft.-Lb.	Marked on Fig. 5
C	Annealed	49,000	49,000	83,000	81,000	20.25	19.0	27.3	29.0	12.80	*C*	17.74	*D*
G	Annealed	48,750	49,500	79,000	80,500	18.5	23.0	30.7	18.7	14.23	*E*	16.05	*F*
B	Forged on mandrel	56,250	55,000	95,750	91,750	23.0	24.25	41.8	50.5	19.88	..	19.95	..
F	Forged on mandrel	53,750	53,750	92,500	97,000	20.5	23.0	47.6	49.1	22.05	..	18.54	..
F	Forged and heat-treated	64,250	64,750	88,750	91,500	25.5	26.2	64.6	65.7	31.50	..	25.38	..
G	Heat-treated casting	58,500	66,750	84,250	91,500	24.2	24.7	48.9	53.2	21.56	..	19.80	..
(6 in.)	Annealed	55,750	56,000	93,000	92,500	13.0	13.5	15.1	9.5	4.61	*G*	5.31	*H*
(32 ¼-in.)	Annealed	55,750	57,000	93,000	94,500	11.2	10.5	13.3	16.9	5.39	*J*	.....	..

TABLE VI. CHEMICAL COMPOSITION AND CHARPY VALUES OF HEAT-TREATED BAR STOCK

Chemical Composition						Heat-Treatments							
C	Mn	S	P	Si	Cr	Original	V_1	V_2	V_3	V_4	V_5	V_6	V_7
0.14	0.45	0.035	0.018	0.131	....	45.39	28.01	38.10	47.18	47.95	49.50	48.34	52.61
0.18	0.56	0.043	0.024	0.132	....	41.51	30.72	35.69	46.24	45.00	44.62	46.87	50.51
0.32	0.51	0.027	0.009	0.128	....	22.96	15.20	10.94	18.85	19.24	19.86	22.34	26.30
0.46	0.40	0.050	0.020	0.144	....	10.70	7.99	.....	14.04	13.96	13.89	15.67	16.60
0.49	0.60	0.028	0.013	0.127	....	12.72	10.32	.....	16.06	14.51	14.35	17.53	19.24
0.57	0.65	0.028	0.012	0.167	....	8.38	7.91	.....	12.57	10.86	11.17	12.02	14.04
0.71	0.67	0.035	0.027	0.147	....	4.42	2.48	.....	.....	4.73	7.60	10.32	15.67
0.83	0.55	0.028	0.018	0.152	....	1.31	1.39	.....	.....	3.42	3.33	4.34	6.36
1.01	0.39	0.029	0.016	0.160	....	2.09	1.47	.....	.....	3.25	3.18	4.19	4.42
1.22	0.34	0.031	0.025	0.181	....	1.39	1.31	.....	.....	2.48	2.09	2.63	2.63
1.39	0.20	0.029	0.015	0.191	....	0.93	0.85	.....	.....	1.86	1.31	1.47	1.62
1.46	0.20	0.035	0.011	0.133	0.35	0.77	1.24	.....	.....	1.94	2.01	2.01	1.94

The heat-treatments were as follows: Original, as received; V_1, annealed just above Ac_3; V_2, hardened in water from just above Ac_3; V_3, hardened in oil from just above Ac_3; V_4, quenched in oil from just above Ac_3 and drawn at 375 deg. C.; V_5, quenched in oil from just above Ac_3 and drawn at 460 deg. C.; V_6, quenched in oil from just above Ac_3 and drawn at 560 deg. C.; V_7, quenched in oil from just above Ac_3 and drawn at 650 deg. C.

The quenching temperatures were:

Carbon	Quenching Temperature Deg. C.	Carbon	Quenching Temperature Deg. C.	Carbon	Quenching Temperature Deg. C.	Carbon	Quenching Temperature Deg. C.
0.14	866	0.46	819	0.71	800	1.22	790
0.18	858	0.49	816	0.83	795	1.39	790
0.32	836	0.57	809	1.01	790	1.46	790

All pieces were held at quenching temperature 20 minutes, and at the drawing heat 30 minutes.

should be made with the reservation that the elastic limit and tensile strength are not so high as gun forgings from which Charpy bars have been taken.

Material used for test consisted of slabs 1½ in. thick which were cut from a 10-in. round ingot, cast in the foundry of Watertown Arsenal.

The chemical analysis was C 0.30, Mn 0.62, Si 0.181, P 0.038, S 0.038. Three heat-treatments were applied—

Treatment A: Heated to 900 deg. C., soaked 2 hours at this temperature and water-quenched, followed by drawing 2 hours at 650 deg. C. and furnace-cooled.

Treatment B: Heated to 900 deg. C., soaked 2 hours at this temperature and furnace-cooled.

Treatment C: Heated to 950 deg. C., soaked 2 hours at this temperature and cooled in air, followed by drawing 2 hours at 500 deg. C. and furnace-cooled.

The impact results as given by the Charpy machine were as follows: Treatment *A*, mean of seven tests, 14.35 ft. lb.; treatment *B*, mean of eight tests, 11.33 ft. lb.; treatment *C*, mean of eight tests, 11.87 ft. lb.

An inspection of the mean results shows that water-quenching has raised the impact strength from 11.33 to 14.35 ft.-lb., while air-chilling and drawing at 500 deg. C. raised the impact strength but slightly.

The chart Fig. 4 shows graphically the results of Charpy tests on twelve forged steels mentioned in the previous article. A repetition is given of the chemical compositions and heat-treatments in Table VI.

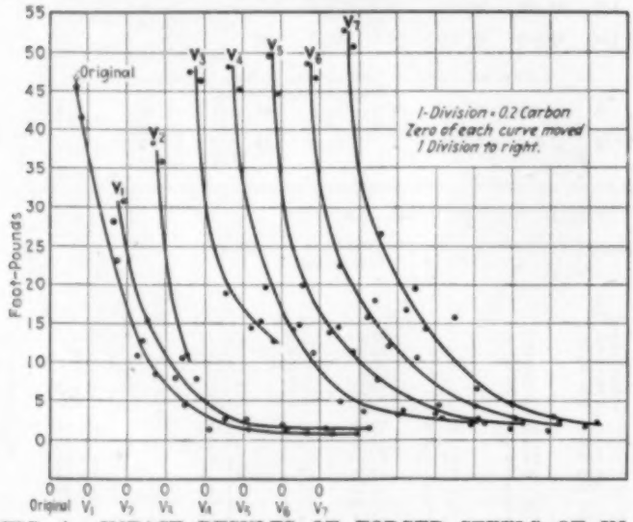


FIG. 4. IMPACT RESULTS OF FORGED STEELS OF INCREASING CARBON CONTENT UNDER VARIOUS HEAT-TREATMENTS

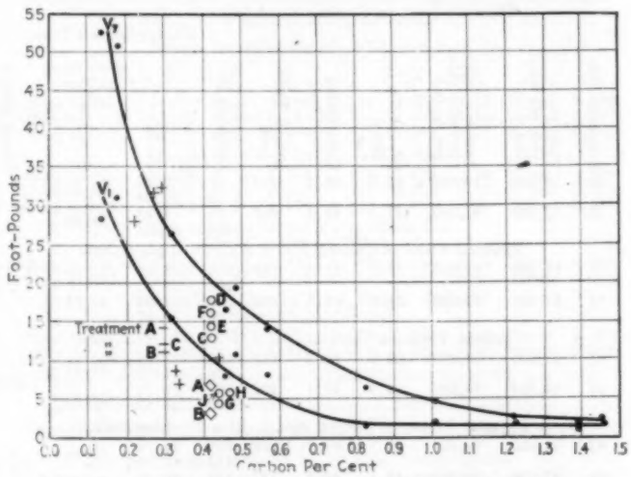


FIG. 5. COMPARATIVE IMPACT VALUES OF CAST AND FORGED STEELS

In the chart (Fig. 5) are graphically summarized and compared the impact results of the various cast and forged steels referred to in this and the previous article.

The diamond mark represents steel castings of "Experiment No. 1" of the previous article, before the American Society for Testing Materials.[1]

The castings each contained 0.42 carbon and 0.86 manganese. They were annealed at 950 deg. C. for 2 hours and air-chilled, then drawn 4 hours at 500 deg. C. Steel *A* represents a phosphorus content of 0.043 and steel *B* represents a phosphorus content of 0.104.

The plus sign represents castings having different carbon and manganese content. The castings had been air-chilled at a temperature of 900 deg. C. The carbon content is shown on the chart and the corresponding manganese content is as follows:

C	Mn	C	Mn
0.44	0.93	0.222	1.29
0.27	1.08	0.33	1.54
0.298	1.31	0.346	1.76

The circle represents steel castings produced by the centrifugal process. Details of treatment, etc., are given above.

The minus sign represents cast steels heat-treated in three different manners, as described above.

Acknowledgment is made to Captain W. B. Bently, now professor of chemistry, Ohio University, who conducted the tests on the investigation of steel castings made by the centrifugal process, and to Nicholas Richardson, research engineer, Watertown Arsenal, who has assisted in compiling data on forged steels.

University Researchers Should Patent Discoveries in Their Own Names

By William J. Hale
The Dow Chemical Co.

In a recent article by William Hoskins and Russell Wiles on the "Promotion of Scientific Research," which appeared in Chemical & Metallurgical Engineering (vol. 24, p. 689, April 20, 1921), we meet with a novel proposition—namely, that universities should patent the inventions of their research men and lease the same to the industries, the proceeds to be applied directly in the continued furthering of research.

The suggestion is indeed worthy of study from the standpoint of both industry and university. The paper is replete with rich suggestions and advice, but the plan in itself affords no ray of hope for financial aid to university research. My critical attitude in this connection will better be condoned if I attack first the weak points and then bestow praise upon the numerous commendable statements made by these authors on the subject of research.

Particular Rather Than General Patents of Industrial Value

1. Foremost of all arguments against the proposition, it must be asserted that patents of general processes are rarely of much pecuniary value. I cannot recall a single instance where a patent on some basic principle yielded a revenue worthy of consideration. True, a number have been sold outright at handsome prices, such as the Nernst lamp, for instance, but the purchasers here, as elsewhere, are the financial losers.

The early basic patents would seem to serve primarily the purpose of an inspiration for subsequent inventors. The basic patent of the sewing machine—an eye in the point of the needle, unheard of in all preceding centuries—yielded nothing. The Selden patent on internal combustion engines with clutch release is at the basis of the great automobile industry, but it survived only a few years till broken.

It is, therefore, the application of some particular phase of these basic discoveries alone that claims the attention of industrialists. It is the particular rather than the general that commands industrial value. No sooner is a new principle promulgated than each conceivable adaptation of it is visualized in every industrial research laboratory in the country. So much better equipped than the average university laboratory for purposes of detailed practical applications, there is little wonder that the industrial scientist can evolve new points of value and points equally as patentable as the general principle itself. In other words, a university laboratory could not be expected to give more than the merest generalization in its claims for patents, and by the time the patent was granted there would be so many more patents pending on details, and especially upon new ideas growing out of the original patent, that the university itself might be forced to pay an appreciable amount in royalties to subsequent inventors in order to present anything attractive for lease to industry.

2. Industries nowadays patent everything. We have had costly experiences when acting to the contrary. We patent to protect ourselves and not to claim any wonderfully conceived new ideas. When thus protected in our operations, we proceed with comparative impunity, as we know we cannot be interfered with. The patents of others little interest us any more than to direct the attention of our research men to still better adaptations of our own particular manufacturing processes.

Difficulties Encountered With More Than One Licensee

3. If there appears some altogether new patent of which we wish to make use, naturally it is to our advantage to buy it outright or lease it on some very small royalty. If another concern desires to lease this same patent, I doubt if we should continue with our lease unless our costs of production were materially lower than our competitor's. It is not worth while to take on extra competition unless you have a material advantage at several points. So soon, therefore, as a university owning rights to a patent began to lease the same to several companies (she never could get much pecuniary assistance from leasing to one company alone) so soon would the value of the patent depreciate and sooner or later the free use of the patent would be forced upon her—a fact made apparent as soon as the university failed to prosecute a single concern using the patent without license. The regular licensees, paying their fees for their own protection, have a right to assume that their leased rights will be guarded by law.

4. A good chemical staff at a large university today with constant and persevering attention to research, where the ultimate goal is financial aid to the university, will scarcely be able to evolve much of a basic nature in the course of a college year. If, however, its concerted action is directed to some particular small problem there is reason to hope for positive results—but think of the "leaks"! You might just as well announce the work at the start. University men are the last to anticipate the valued factors in their researches. In other words, a corps of men at an industrial plant are so much more advantageously situated with scientific, material and legal equipment that a new idea, no matter how crude its conception, can be safely secured for their industry long before the university men realize what they are at work upon. When, however, the university man works alone or with a close collaborator and the question of time is left out of consideration, we find many discoveries to his credit, and patents have usually followed free from outside interference.

The Question of Patent Counselors

5. I know of no type of university man willing to grant that patent counselors could be helpful to university scientists. The scientific men fully realize that these counselors are anything but scientists. They may have had some scientific training, but they are not capable of diagnosing scientific problems save where exactly similar questions have been a matter of study between them and the Patent Office. The only possible help from the patent attorneys would be in the form of a comprehensive report from them on all patents bearing on the general processes involved. With such reports at hand, the investigator cannot do better than consult privately with industrial leaders, men of high standing in their profession and in their community. These men and these men alone are the only men who can help the inventor. Though this is, indeed, solid truth, some way or other I just can't picture to myself the solicitation of advice from industrial leaders on the part of our university professors.

6. There is nothing dishonorable in a university scientist seeking a patent. On the contrary, he gains enormously thereby in international prestige. Of course he usually is condemned at home by the university drones unable to comprehend the value of ideas other than their own; but such childish criticisms are negligible. No true scientist doubts for a moment the rights of a man to patent his own inventions. The great majority of our well-known chemists of England, France and Germany are holders of patents in their respective countries. In this country the so-called baneful influence of the industries has been held over young scientists as a sword of Damocles, so to speak, but I assure you the sword is now sheathed. The real inventor or discoverer should have a right to his own ideas and he alone should reap what little benefits may accrue therefrom.

Need for Great Increase in Scientific Research

This paper of Messrs. Hoskins and Wiles presents a number of points in which one must concur with the highest commendation. "An immense increase in scientific research is perhaps the most important future step for the welfare of this country." This is a truth of such limitless scope that we can scarcely realize its import. These authors avow that researches must begin as pure science and take the direction of applied science in order to raise the standards of the physical well-being of our people. At this point Messrs. Hoskins and Wiles introduce the crux of the whole matter: "Industry is taking care of the application of science." The university therefore must stimulate the researches in pure science, else "the stream will dry up."

The establishment of a 10-year period for research in pure science for a man after receiving his doctorate is all well enough and admirable for the future of both university and industry, no matter where the young man casts his lot, but the salary paid is usually so small during the early years of this constructive period that barely a living wage is afforded the scientist. Physically he may become more or less a wreck.

The financing of these men and their investigations brings out the proposal which the authors have suggested. They argue that the industries will gladly pay for patents thus obtainable after assignment to the universities. This is all true enough, but, as stated in my foregoing criticism, there will be so little of patentable nature that the university and the investigator will reap greater renown if he goes on his quiet way with never a thought of patent or legal advice until he himself runs across something which he recognizes is new and which he is anxious to secure in his own name. A man in this age unable to recognize at least the partial value of his discoveries is really to be pitied and actually to be classed as a moron; I doubt if universities should countenance his presence too long among the more intellectual. The custom of university scientists in presenting purely scientific papers is highly to be commended. I would that we industrial men could get the time to contribute likewise in this capacity. Just where Messrs. Hoskins and Wiles find authority for the statement, "It seems to be agreed that to permit members of the scientific faculties at our universities to patent their discoveries for their own personal benefit is an entirely wrong procedure," is unknown to me. It strikes me as of ancient mariner lore—antique in thought maybe, worthy of admiration and praise for the goodly influence in the past, but in this dynamic age certainly out of harmony. In practically every university today there are professors of chemistry who hold patents and there will be more and more as university men awake to their possibilities.

The one point which Messrs. Hoskins and Wiles would bring against this right to patent in the name of the scientist is that this action may tend to restrict the direction of research into lucrative fields, especially in the realms of applied science. This indeed is the strongest criticism of the procedure and one in which I have interested myself to a large extent. In order to avoid this pitfall I have advocated an actual payment for research in pure science. (*J. Ind. Eng. Chem.*, vol. 12, p. 690, 1920.) Somewhat later, when industrial conditions are improved, I hope this question can be brought up again. To deprive the university scientist of the right to patent in his own name and reap whatever profits accrue would indeed destroy about the last vestige of incentive left to him. High salary and high recognition with promotion come only slowly, owing to the dead timber still standing; the university therefore cannot safely consider a step so likely to drive its research men into research and industrial institutes.

Special Research Fellowships

The founding of special research fellowships, particularly where the donor is a scientist himself and directs (though indirectly) the research work of the Fellow, is an admirable example of what we may hope for under favored conditions, and with this practical suggestion I believe Messrs. Hoskins and Wiles have admirably described a means of co-operation of university and industry.

Metallurgical Examination of Broken Crankshaft

A broken crankshaft from a 10-ton ammonia refrigeration machine was submitted to the Bureau of Standards for examination by one of the other Government departments. The material proved to be inferior in that it was decidedly porous and showed evidence of not having received sufficient reduction in forging. The break which occurred was in the nature of a fatigue failure and had its origin in the angle between one of the throws and the bearing. A defect at this point had been filled in previously with arc-fused metal. Such a procedure would not necessarily lead to failure had the defect been located elsewhere, but at the point in question the stresses are much higher than at other points on the shaft, and the break once started would be propagated rapidly owing to the unsound character of the steel.

Present Status of German Leather Industry

A cablegram from the representative of the Department of Commerce, Berlin, reports that German tanneries are producing calfskins, patent leather and kid leather up to 65 or 75 per cent of their pre-war output. The tanners are receiving adequate supplies of raw hides and skins to keep the industry occupied. France is supplying 70 per cent of the calfskins and 90 per cent of the kid leather. Denmark and Sweden are other sources of supply; England sends additional patent leather, Russia virtually nothing. Labor conditions in the leather industry are satisfactory, with almost no unemployment. Present wages per hour of 6.25 to 8 marks compare with 1913 rate of 45 to 65 pfennigs per hour.

Contrast Etching for Metallographic Specimens

By Henry S. Rawdon* and Marjorie G. Lorentz*

THE terms "contrast" etching and "plain" etching are used to designate the character of the results obtained with different reagents upon any type of alloy and particularly those consisting of one constituent such as the "pure" metals, the α brasses and bronzes, β brass, etc. Microscopic examination of sections of such materials after plain etching usually reveals only the grain boundaries, as a network of black lines together with such extraneous features as inclosures. The grains themselves show no "individuality" other than that of shape and size. However, in the same material after contrast etching, each grain has an individuality of its own which is the result in large measure of its relative brightness as compared with the neighboring grains. The plain etch-pattern bears much the same relation to the contrasted one as a simple outline sketch of a group of objects does to the completed drawing of the same. For general purposes, the contrast etch-pattern is usually preferred, although in some cases, particularly for examinations at high magnification, the plain etching is the more desirable one to use.

Contrast may be developed in at least two very different ways. If the polished surface of the specimen

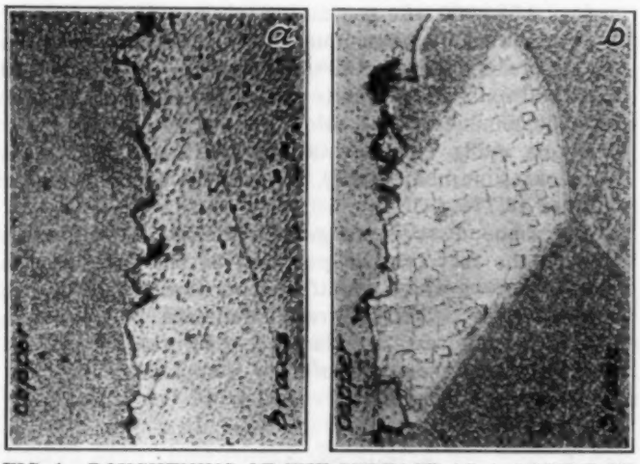


FIG. 1. ROUGHENING OF THE SURFACE AS A RESULT OF PROLONGED ETCHING. × 500

A polished section of an alpha brass (Cu 69, Zn 31 per cent) was etched 12 hours in 50 per cent copper ammonium chloride and a section perpendicular to the etched face was then examined after etching with copper ammonium chloride. Note the similarity in orientation of the notches in the etched surface of *a*, which represents a portion entirely within a single crystal. Note in *b* how the orientation of the notches of the etched surface is the same as that of the etching pits within the crystal.

is etched sufficiently, the surface metal is dissolved and a differential roughening of the various grains will result as the crystalline facets are revealed within the boundaries of the different grains. Since the orientation of all the facets within any particular grain is the same, it follows that practically all the light incident upon such an etched surface of a crystal will be reflected in a definite manner. The direction of the reflected beam varies for different grains depending upon the difference in the orientation of the crystalline facets from grain to grain. Thus a crystal-grain will appear light or dark according to the position of the eye of the observer with respect to the beam reflected from this crystal.

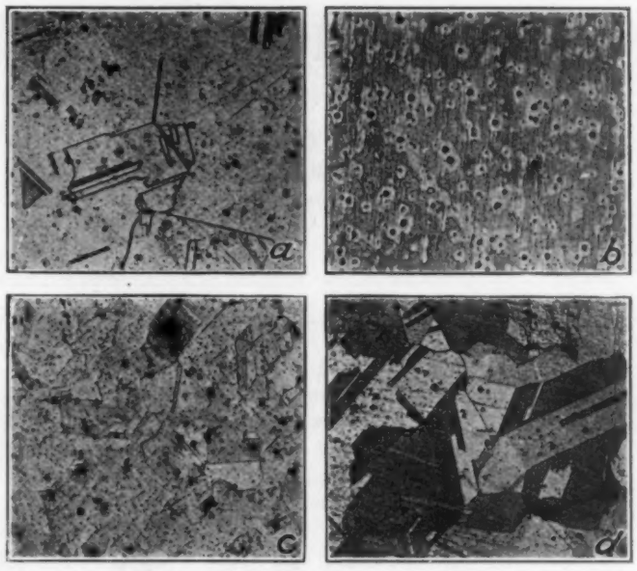


FIG. 2. MICROSTRUCTURE OF BRASS ETCHED BY MEANS OF HYDROGEN SULPHIDE. × 85

a. α brass (Cu 67, Zn 32, Pb 1 per cent) etched with 10 per cent solution of silver nitrate. Note the absence of contrast.

b. Same specimen as *a*, which after polishing was suspended in an atmosphere of hydrogen sulphide for 1 minute, and acquired a surface film of sulphide. Black spots mark inclusions of lead.

c. The specimen after being etched as in *a* was placed in hydrogen sulphide as in *b*. The contrast of the etch pattern produced was much less pronounced than in *d*.

d. The specimen after being filmed by means of hydrogen sulphide as in *b* was etched with silver nitrate solution as in *a*. A brilliant contrast results.

The nature of the roughening produced by very deeply etching a specimen of brass (copper 69, zinc 31 per cent approximately) is shown in Fig. 1. The contour of the roughened surface was revealed by using sections perpendicular to this surface, precautions being first taken to protect it by means of a coating of electrolytically deposited copper. The micrographs plainly show the regularity in the roughening of a crystal produced by etching and also that it conforms to the crystalline orientation of the grain as revealed by the etching pits. This means of producing contrast is well understood and has been frequently described. The second method, however, is not so well known.

It is often desirable in the study of the microstructure of metals to produce contrast without much roughening of the surface. This may be accomplished by the use of reagents which cause the formation of a very thin film on the surface, the thickness of which varies from grain to grain. This effect has been described in considerable detail for copper[1] and is usually attributed to an oxidation film. The part that such films play in contrast etching may be revealed rather strikingly, as shown in Figs. 2 and 3, by a double etching process in which the filming operation is separate from that of etching.

Hydrogen sulphide gas may be used as a convenient means for producing a thin film on the specimen and an aqueous solution of silver nitrate as the reagent for etching which, of itself, produces little if any contrast (Fig. 2*a*). When the slightly warmed polished brass specimen (copper 67, zinc 32, Pb 1 per cent, approximately) was suspended in a bottle by hydrogen sulphide to which a drop of concentrated hydrochloric acid had been added to accelerate the action, a film having the appearance shown in Fig. 2*b* was produced. (It may be noted here that hydrogen sulphide of itself,

By permission of the Director, Bureau of Standards.

*Physicist (metallography) and assistant physicist, respectively, Bureau of Standards.

[1]Henry S. Rawdon and Marjorie G. Lorentz, "Metallographic Etching Reagents. I—For Copper," Bureau of Standards Sci. Paper 399 (1920).

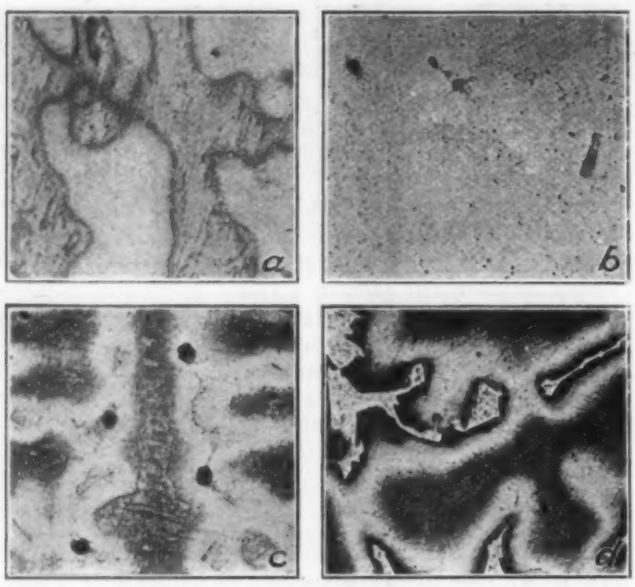


FIG. 3. MICROSTRUCTURE OF CAST BRONZE. × 85

a. Cast zinc bronze (Cu 88, Sn 10, Zn 2 per cent) etched with 10 per cent solution of silver nitrate. Adhering silver covers the eutectoid constituent.

b. Specimen *a* which, after polishing, was placed in an atmosphere of hydrogen sulphide for 1 minute.

c. Specimen *a*, filmed by hydrogen sulphide as in *b*, then etched with silver nitrate as in *a*.

d. Specimen *a*, etched with silver nitrate and then exposed in hydrogen sulphide as in *b*.

A brilliant contrast is produced. The adhering silver covering the eutectoid (see *a*) protects this constituent from the action of the sulphide and thus increases the contrast.

particularly if dry, has an almost negligible effect upon a metal; a trace of acid fumes, however, quickly causes a heavy sulphide film to form.) No evidence of crystalline structure was revealed by the hydrogen sulphide attack. On the other hand, when a specimen etched by means of silver nitrate solution was introduced into the hydrogen sulphide atmosphere, the sulphide film formed on certain crystals with greater readiness than on others, so that a slightly contrasted etch-pattern resulted (Fig. 2*c*). However, the best results by far were obtained by first producing a uniform sulphide film on the polished surface of the specimen and then etching the filmed sample in the silver nitrate solution (Fig. 2*d*). Such a procedure gave excellent results with α brasses and αβ brasses. With cast bronze (copper 88, tin 10, zinc 2 per cent), excellent results were obtained by producing the sulphide film on the etched surface rather than by etching the previously filmed specimen (Fig. 3). It will be noted in Fig. 3*a* that after etching with silver nitrate, the eutectoid constituent of the bronze remained coated with a deposit, presumably precipitated silver. This deposit protected this constituent from the action of the hydrogen sulphide gas to some extent when the etched specimen was introduced into the gas and so added to the contrast of the resulting etch-pattern.

The fact that the results given above are of rather general application and do not depend upon any peculiar properties of the sulphide film was demonstrated by using oxide films instead of sulphide. Specimens of brass were gently heated on a hot plate in the air until they were uniformly coated with oxide and were then etched with silver nitrate solution. The very striking contrast pattern produced as a result of this procedure is shown by Fig. 4. A somewhat similar effect sometimes results when a specimen is polished too long on a wheel which has been allowed to become nearly dry. Ferrite, for example, may under such circumstances develop a black-and-white contrast pattern upon etching instead of showing its usual appearance.

For demonstration purposes, one is restricted somewhat in the choice of reagents used, since it is necessary that the solution used be one that produces a "plain" etch-pattern. For practical use, of course, this limitation does not hold.

FIG. 4. MICROSTRUCTURE OF ANNEALED BRASS. × 85

The polished specimens were heated for 10 minutes on a hot plate in the air, so as to produce a uniform oxide film. The oxidized specimens were then etched with 10 per cent silver nitrate solution.

Development of the Gas Industry

A survey completed by the American Gas Association reveals in striking degree the magnitude to which the gas service of the nation has grown. Some interesting statistics are:

Gas furnishes the cooking heat, and in many cases illumination, in the homes of over 49,000,000 citizens.

Communities served with gas number 4,600 and meters 8,580,000, the gas mains totaling 68,300 miles.

To make the gas consumed by households and industry last year required 8,500,000 tons of bituminous coal, 2,000,000 tons of anthracite coal, 1,500,000 tons of coke, and 960,000,000 gal. of oil.

Hotels, clubs, restaurants and institutions using gas for cooking number 71,490, while those using it in part number 13,776.

The tremendous use of gas for industrial purposes is seen in the fact that 25 per cent of the nation's consumption is now by manufacturing concerns, it being used in over 1,500 different processes. The steady growth is recorded in the following table, compiled from Brown's Directory of Gas Companies:

GAS SALES BY YEARS, 1901 to 1920

	Cu.Ft.		Cu.Ft.
1901	101,625,366,000	1911	159,100,674,000
1902	92,714,667,000	1912	178,228,754,000
1903	105,676,479,000	1913	188,285,840,000
1904	113,930,140,000	1914	198,838,834,000
1905	112,444,237,000	1915	204,309,522,000
1906	122,849,725,000	1916	231,381,313,000
1907	132,011,582,000	1917	264,493,003,000
1908	138,570,073,000	1918	271,593,141,000
1909	143,117,693,000	1919	306,632,786,000
1910	149,430,549,000	1920	319,887,813,000

Domestic Production and Imports of Hides and Skins, 1920

The domestic production of hides and skins in the United States during 1920 exceeded the imports of foreign ones by 150,000,000 lb. The estimated output for the year was 849,530,000 lb., the imports aggregated 700,113,000 lb.—both on a "green" basis. These totals, as tabulated in *Commerce Reports*, included:

Kinds of Hides and Skins	Domestic Production,* Lb.	Imports† Lb.
Cattle hides	673,676,000	334,475,000
Calfskins	115,954,000	52,035,000
Sheep and lamb skins	29,719,000	112,523,000
Horse, colt, ass	30,000,000	21,890,000
Buffalo hides	.....	20,727,000
Goatskins	181,000	150,074,000
Kangaroo and wallaby skins	.....	1,389,000
All other hides and skins (exclusive of furs)	.....	7,000,000
Total	849,530,000	700,113,000

* Estimated.

† Converted to a green basis, 1 lb. of dry equal to 2 lb. of green.

Recent Developments in the Sulphuric-Acid Industry—II*

Review of Such Modern Tendencies in the Chamber Process as the All-Masonry Construction of Towers, the Introduction of Interchamber Towers and So-Called Cooling Chambers, and Recent Changes in Design of Acid Chambers and Accessories

BY ANDREW M. FAIRLIE
Consulting Chemical Engineer

IT IS the intention of the author to confine himself in the present paper to a review of the more recent advances which have been made in the manufacture of sulphuric acid, particularly as these developments affect the design, construction and operation of Glover and Gay-Lussac towers and of chambers and their accessories.

Acid-proof masonry without lead curtains, as applied to Glover-tower construction, is a development of recent years. The first all-masonry acid-proof towers built in this country were erected at Nitrolee, S. C., in 1911, of stone and an acid-proof cement imported from Germany, and were used as nitric-acid towers. Later, in 1914, all-masonry towers were built for a phosphoric-acid plant at Mt. Holly, N. C., and these towers, so far as known, were the first all-masonry towers to be built of American-made chemical brick and cement. The bricks for the Mt. Holly plant were furnished by the B. Mifflin Hood Brick Co., of Atlanta, Ga., and the cement by the Chemical Construction Co., of Charlotte, N. C. The first all-masonry acid-proof towers for use in a sulphuric-acid plant were built at Macon, Ga., in 1914. Since then many acid-proof all-masonry towers—Glovers, Gay-Lussacs and concentrators—have been built in all parts of the country.

The steel supports of a Glover tower designed by the Chemical Construction Co. and also the manner of packing the tower are shown in Fig. 4. Manufactured forms of packing ordinarily are not used in the Glover tower, on account of the danger of cracking and collapsing under the intense heat. The Glover tower is usually packed with checkerwork chemical brick, with graded sizes of lump quartz, or with a combination of the two, the quartz on top.

Different views of the Glover and Gay-Lussac towers built for the new 250-ton plant of the Union Acid Works, Baltimore, Md., are shown in the accompanying illustrations. Fig. 5 shows the masonry Glover and Gay-Lussac towers under construction; Fig. 6 the masonry Glover towers (in left foreground) and masonry Gay-Lussacs (in left background) completed, with lead draft pipe from the last chamber entering the bottom of the first Gay-Lussac; Fig. 7 acid distributors on top of Glover tower and upper part of first Gay-Lussac tower, with acid distributors on top. In this photograph the method of staying the brickwork with angle-irons, tee-irons and tie-rods is clearly shown.

A form of tower construction recently designed for hot gases and acids is controlled by Perry & Webster, Inc., of New York City, and has been described and illustrated by Wells and Fogg in Bureau of Mines Bulletin No. 184.†

At one or two chamber plants recently constructed so-called "cooling towers" or "cooling chambers" have been introduced. The plants where such "cooling towers" have been installed have chambers of unusually large cubic capacity in proportion to total lead surface of tops and curtains. It is to compensate for the deficiency of heat-radiating surface of such large chambers that the small "cooling chambers," which have an unusually small volume of cubic space in proportion to area of lead surface, are installed. Properly speaking, the chambers themselves are just as truly cooling chambers as are the smaller structures to which the name "cooling chambers" has been applied. As the "cooling chambers" are made of the same materials as the chambers proper, their object is not to effect any necessary preliminary cooling of the gases prior to admission into the large chambers, as obviously gases hot enough to damage the large lead chambers would also damage the small ones. At the plant of the Tennessee Copper Co., where there were originally installed sixty-four cooling chambers 10 ft. 8 in. x 10 ft. 8 in. x 70 ft. high, and eight cooling chambers of the same width and height but twice the length, it was usual to find that the temperature of the gas in the second large chamber was higher than that of the gas in any of the "cooling chambers."

These cooling chambers were, nevertheless, very effective for the real purpose for which they were installed —namely, to supplement the large chambers for the radiation of the heat of the reactions and thus effect a lower temperature of the gas mixture entering the Gay-Lussac tower, resulting in improved niter recovery.

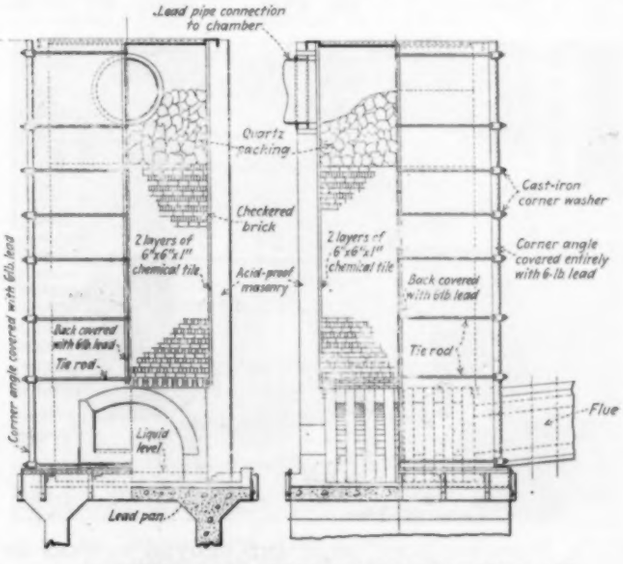
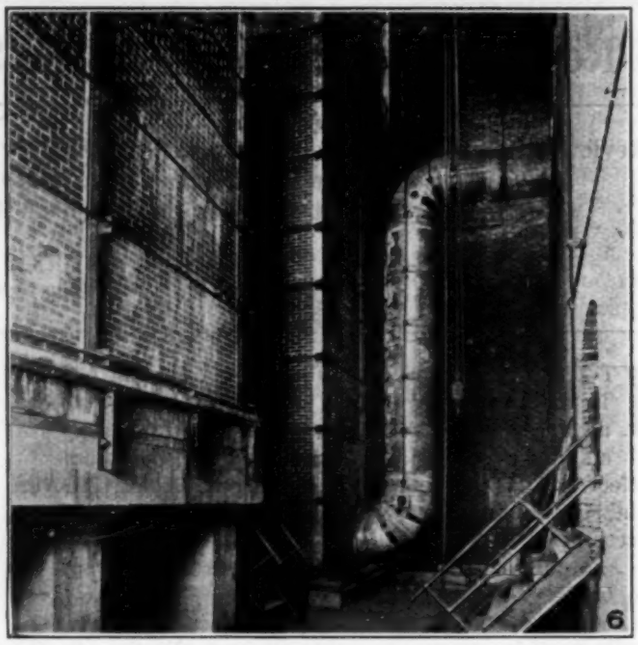


FIG. 4. STEEL SUPPORTS AND PACKING FOR ALL-MASONRY GLOVER TOWERS

*For Part I see CHEM. & MET. ENG., vol. 25, No. 19, p. 861.

†"The Manufacture of Sulphuric Acid in the United States," by A. E. Wells and D. E. Fogg, U. S. Bureau of Mines, 1920, p. 143.



FIGS. 5 AND 6. ALL-MASONRY GAY-LUSSAC AND GLOVER TOWERS AT UNION ACID WORKS, BALTIMORE. UNDER CONSTRUCTION (FIG. 5) AND COMPLETED (FIG. 6)

No radical changes in the design of sulphuric-acid chambers have been developed in the United States within recent years. During the war the total chamber plant capacity of the entire country was vastly increased, and some of the plants whose construction was undertaken by the Government were of unusual size. Among these may be mentioned the Pratt Process plant at Little Rock, Ark., practically 100 per cent completed at the time the armistice was signed, and the 800-ton plant at Brunswick, Ga., which was only 40 per cent completed on armistice day, soon after which construction was stopped.

Construction on the two-unit plant of the Union Acid Works, at Baltimore, Md., designed and built by the Chemical Construction Co., was started in April, 1920. One unit of a capacity of 150 tons 50 deg. Bé. acid was completed in January and the second unit was completed in August of this year. Each of the two units consists of three Glens Falls sulphur Burners, one Glover tower, two Gay-Lussac towers built as one structure with a downtake for the gases between, six chambers, and five interchamber towers. The Glover tower is 17 ft. square outside by 31 ft. high and has walls 18 in. thick throughout. The Gay-Lussac tower structure, with downtake included, measures outside 17 ft. x 30 ft. 8 in. x 48 ft. high, and the towers inside are 12 ft. 5½ in. x 14 ft. in horizontal cross-section. The brick walls of the Gay-Lussac towers are 18 in. thick from the foundation up to a height of 21 ft., and from that point to the top are 14½ in. thick. In each unit three of the chambers are 60 ft. x 30 ft. x 40 ft. high, two are 70 ft. x 30 ft. x 52 ft. high, and the last one is 40 ft. x 30 ft. x 52 ft. high. A view of the chambers during construction is shown in Fig. 8, wherein the chambers of the completed unit are on the right, with scaffolding for lead burners still hanging in the steel framework, and the pan of one of the chambers of the unfinished unit is in the foreground. All acid pumping at this plant, with the exception of acid delivered to the storage tanks, is done by means of airlifts. Chamber hydration will be by means of water atomizers with 1½-in. lead supply lines.

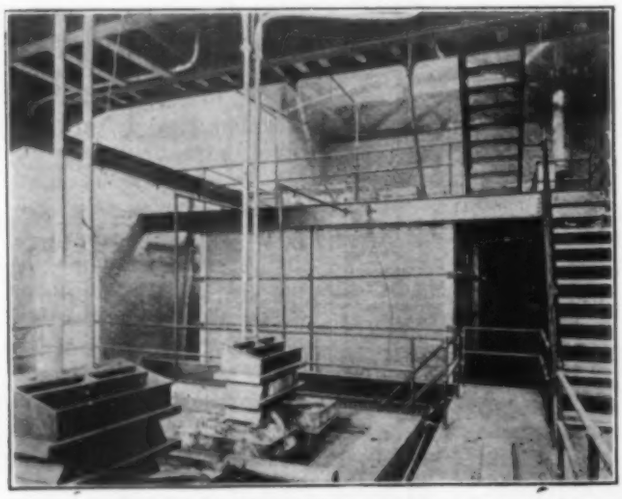


FIG. 7. TOPS OF GAY-LUSSAC AND GLOVER TOWERS OF ALL-MASONRY CONSTRUCTION, SHOWING ACID DISTRIBUTORS

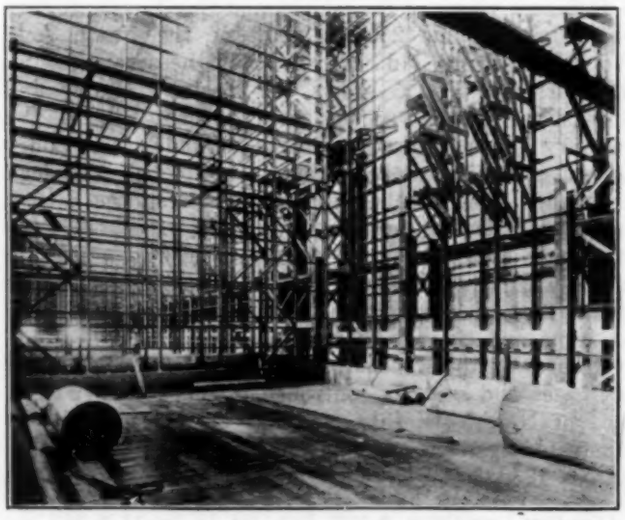
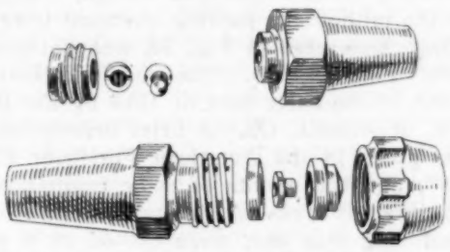


FIG. 8. LEAD CHAMBERS OF UNION ACID WORKS DURING CONSTRUCTION

Shortly before the outbreak of the war a new and unusual type of sulphuric-acid chamber was brought out in England. This was a radical departure from the long-established rectangular chamber in that it was shaped in the form of a truncated cone, and was designed for the application of flowing water on the outside of the lead curtains or walls. This new chamber is known as the Mills-Packard acid chamber, a description of which appeared in a recent issue of CHEMICAL & METALLURGICAL ENGINEERING.[10] By means of the Mills-Packard chamber the chamber space required per pound of sulphur burned has been reduced to from 3.5



FIGS. 9 AND 10. STONEWARE WATER-ATOMIZING NOZZLE FOR SULPHURIC-ACID CHAMBERS. FLANGED TYPE SHOWN ABOVE AND THREADED TYPE BELOW

to 4.5 cu.ft. The first chamber of this type was built in 1914, and its success is attested by the fact that since then 110 Mills-Packard acid chambers have been built.

Water has almost entirely superseded steam in the United States as a means of hydration in the chambers. In some plants in the Northern States steam is still

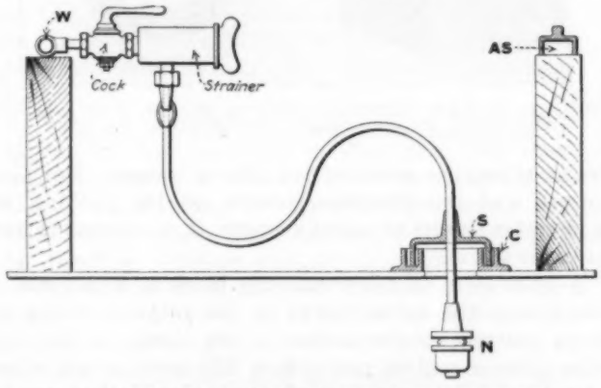


FIG. 11. INSTALLATION OF ATOMIZING NOZZLE IN TOP OF CHAMBER

C—Lead cup. *S*—Lead seal. *N*—Nozzle. *W*—Water supply to cock and strainer. *AS*—Spare seal.

used during the coldest months, owing to possible danger of freezing the water pipes unless the latter were drained. At other plants water is used throughout the year, except on the last chamber or last two chambers. As far north as Baltimore it has been found practicable to use water on all the chambers throughout the year.

The atomizers used for spraying the water inside the chambers are of various types, and include the Witclay nozzles of the Schutte & Koerting Co., the "Spra-rite" atomizing nozzles of the Binks Spray Equipment Co. and the stoneware atomizers of the Monarch Manufacturing Co. Fig. 9 shows the latest design of the Monarch stoneware atomizing nozzles, threaded type, (U. S. Pat. 1,099,028). The disk has two or more small exposed surface grooves, molded tangential to the circumference of a concave circular space at the bottom. These grooves are equal distances apart. The water, forced through these grooves against the concave circular space, acquires a rotary motion, and is emitted from the nozzle as a fine mist. The flanged type is shown in Fig. 10. This nozzle has the advantage that, if it becomes clogged, it can usually be cleaned by inserting a pin through the small orifice (without shutting off the water supply), thereby lifting the disk and allowing the water to flush out the obstruction. If necessary, the grooves of the disk can readily be cleaned with a brush. Fig. 11 shows an installation of a water atomizer within a chamber, with lute (*C*) and lute cap (*S*) on the chamber top, and showing also the strainer and cock. The Monarch Manufacturing Co. has recently developed a new type of water strainer, to be used with their atomizer, as shown in Fig. 12, in which the strainer is not soldered, as in the old type, to the basket. The Duriron Co. has very recently developed a new type of atomizing nozzle, to be made of

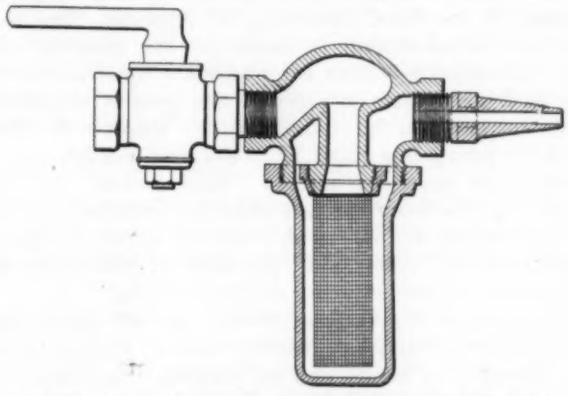


FIG. 12. A NEW TYPE OF WATER STRAINER FOR USE WITH WATER ATOMIZERS IN ACID CHAMBERS

Duriron, for acid chambers, on which four patent claims have been allowed. It is not yet on the market.

The interchamber towers for the plant of the Union Acid Works at Baltimore are 7 ft. wide x 29 ft. long x 24 ft. high. There are five of these towers at each unit, and they serve as coolers and mixers of the gas on its way from one chamber to the next. These towers are built with steel frames supporting lead curtains,

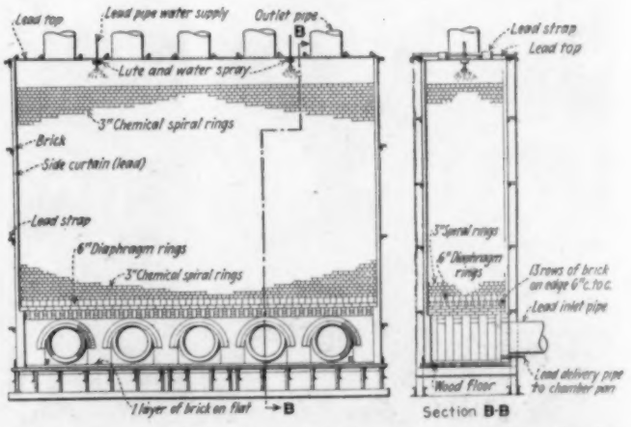


FIG. 13. ELEVATION AND CROSS-SECTION ON INTERCHAMBER TOWER DESIGNED BY CHEMICAL CONSTRUCTION CO.

[10] "Water-Cooled Acid Chambers Adopted in England," CHEM. & MET. ENG., vol. 24, No. 18 p. 786, May 4, 1921.

FIG. 14. SPIRAL RING TOWER PACKING BLOCK

which are lined with a 4-in. brick wall. The towers are packed with staggered rows of 3-in. spiral rings furnished by the Hood Brick Co., of Atlanta. The elevation and cross-section is shown in the drawing (Fig. 13). Atomizing nozzles for water are inserted through the lead top. Data relative to the results obtained in such towers can be found in the Bureau of Mines Bulletin previously cited by Wells and Fogg.[11]

At some plants a packed "filter tower" has been introduced between the last chamber and the first Gay-Lussac tower, to aid in drying the gases by passing them over the condensing surfaces of the packing in this tower, before entering the Gay-Lussac.

All-masonry Gay-Lussac towers do not differ materially from all-masonry Glover towers, except in size, in thickness of walls and in packing materials. The first all-masonry Gay-Lussac towers were built with walls 8 to 10 in. thick; but it was found that acid would seep through these walls in places, and the thickness of Gay-Lussac tower walls has been increased to a minimum of 14 in., and in the newest towers the lower part of the tower walls is 18 in. thick. Two or more Gay-Lussac towers, with the downtake for gas between, are commonly built together as a single masonry structure. uch a structure is shown in the photographs of the masonry towers of the Union Acid Works (Figs. 5 and 6). Gay-Lussac towers, as usually designed, are taller, and narrower in horizontal section, than the Glover tower of the same plant. At some plants a single tall Gay-Lussac tower is employed, but usually two towers somewhat less in height are preferred, and lately there has been a growing tendency to add a third tower, and the effect of this in reducing niter losses has been found to justify the expense.

[11] *Op. cit.*, p. 108.

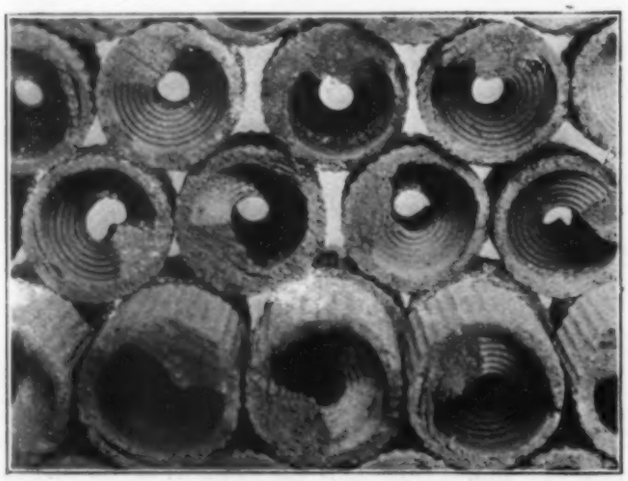


FIG. 15. TOP VIEW OF TIER OF SPIRAL RINGS STACKED IN TOWER

During recent years the use of coke for packing Gay-Lussac towers has been gradually becoming less popular. Checkered brick or tile have been used to some extent, and since the advent of the "spiral ring," a manufactured packing block of peculiar design, this has been used by the million for packing chemical towers. The spiral ring, illustrated in Fig. 14, was patented by A. M. Webb,[12] Feb. 4, 1919. The ring was first put on the market in the early part of 1918 by the B. Mifflin Hood Co., of Atlanta, Ga. A brief description of this ring was given in the American Fertilizer Handbook for 1918[13]; and the results of some comparative tests made on different types of packing materials, of which the spiral ring was one, were quoted in a paper by Zeisberg.[14] The appearance of a layer or tier of spiral rings, as stacked in a tower, is illustrated in Fig. 15. The spiral ring is not recommended by the manufacturers as a packing material for Glover towers. For Gay-Lussac and interchamber towers, or for packing the acid-making units of tower systems, it is claimed to have superior merit.

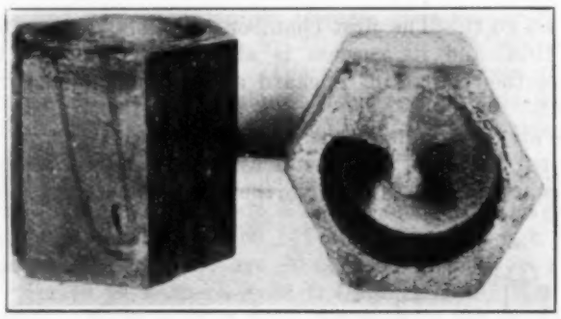


FIG. 16. A NEW TOWER PACKING BLOCK, HEXAGONAL EXTERIOR WITH HELICAL FLANGE INSIDE

A new form of tower-packing block is hexagonal in shape, and the spiral flange in the interior either extends entirely to the center of the block, or its inner edge joins a central post which fills what would otherwise be a hole, extending through the block from top to bottom. This block is shown in Fig. 16.

The hexagonal block, which has been given the trade name "Hexahelix," was developed by the author, and is protected by U. S. Patent 1,365,671. The hexagonal exterior shape has the peculiarity that six blocks can be exactly fitted around any one block, without leaving voids or spaces between blocks. The internal spiral flange is so designed that gases and liquids are compelled to pursue a spiral or tortuous course, and cannot take a vertical or short-cut course, in passing through a block. The combination of the external with the internal features of these blocks, when stacked regularly in a tower (not staggered) compels a tortuous winding flow for both gases and liquids.

(Part III will appear in a subsequent issue)

Atlanta, Ga.

[12] U. S. Pat. 1,293,370.

[13] *Op. cit.* p. 82.

[14] F. C. Zeisberg, "The Resistance of Absorption Tower Packing to Gas Flow," *Trans.*, Am. Inst. Chem. Eng., vol. 12, part 2, p. 231.

National Tube Co.'s New Plant for Hammer-Welded Pipe

Welded Pipe Up to 8 Ft. Diameter, Having Various Kinds of End Joints, Made in Highly Specialized, Massive Machinery—Details of Welding Machines and Welding Practice—Finishing Department Handles an Important Branch of the Work

By ERNEST EDGAR THUM

PREVIOUS articles[1] [2] have discussed the general subject of welding in its branches inherited from ancient times and its recent adaptations, showing that until late years there had been no method devised for making large vessels without lap joints which would safely withstand heavy shocks and pressures. A plant built for heavy welded work by the Blaw-Knox Co. was also described, and its operation discussed in some detail. It is now the intention to present similar data on a large and well-equipped plant for making welded pipe from 24 in. up to 96 in. diameter installed by the National Tube Co. at its Christy Park Works, at McKeesport, Pa.

Need for Large Pipe

It is doubtless well known that the smallest sizes of wrought-iron and steel pipe (less than 3 in. internal diameter) are made by butting the edges of the hot bent plate and forcing them together by drawing them through a forming die. Piping from 2½ in. up is made by lap welding; the edges of the skelp are slightly beveled, the bent plate is reheated and rolled over a mandrel. Brief mention of the methods and properties of such welds was made in the first article of this series, page 558.

While lists of dimensions, published in handbooks, show lap-welded pipe up to 36 in. diameter, such sizes are rarely obtainable, if at all. In fact any lap-welded pipe over 20 in. diameter is very difficult to make and handle. The flat skelp itself is over 5 ft. wide, the scarfing, bending, welding and straightening rolls—in fact, all the mechanical equipment—become quite bulky, the capacity of the furnaces is limited to a very few pieces, and the handling is either very laborious, or, if done by machines, fraught with possibilities of damage.

Nevertheless there are certain definite advantages of wrought over cast iron, and riveted pipes. Cast iron is of course out of the question for high-pressure work, and there are many places in low-pressure lines where it is essential that the frictional loss be held to the minimum, or, stated in another way, that the carrying capacity of a given diameter should be a maximum. The velocity of flow in riveted pipe is approximately 18 per cent less, and in cast iron, 10 per cent less, than in steel pipe having smooth walls, free from scale and projections at the joints. Making allowance for such factors, the engineers of the National Tube Co. have calculated that in a penstock, bearing 270 lb. pressure and passing 200 cu.ft. water per second, a hammer-welded pipe of ⅝-in. plate, 48 in. diameter will be the equivalent of a 52-in. pipe of ⅞-in. plate, triple-riveted longitudinal and double-riveted circular seams. Weight of the welded pipe per ft. is 340 lb., against about 540 lb. for the riveted.

Water mains might advantageously be laid of these pipes in many locations, particularly high-pressure fire lines. Siphons on ditches and aqueducts, as well as conduits on principal water supplies, also suggest themselves. Gas lines of welded pipe would avoid many chances of loss by leakage, while much piping for hot or cold air about metallurgical plants would doubtless remain more efficient if it had fewer riveted joints. These are the principal uses which produce a demand for a considerable tonnage of large pipe and which determined the National Tube Co. to supplement its existing plants with facilities for making hammer-welded pipe 24 in. diameter and larger.

Hammer-Welding Department at Christy Park

Sufficient room was available at the Christy Park Works (where seamless tubing and bottles are made by cupping and deep-drawing) and a new department was added to that plant.

The mill building is L-shaped, one leg consisting of two adjacent bays, of 90 ft. and 50 ft. span respectively, where the pipe is manufactured from flat plates. In the other bay, 75 ft. wide, at right angles to the foregoing, the finishing and testing is done. All this area is under cover of the most substantial kind of mill building, light and airy, and commanded by overhead cranes. Flat plates entering the plant aboard cars are handled exclusively by magnets. Serving the bending rolls, welding machines and annealing furnaces is a special charging crane.

All piping and wiring, except the 24-in. main for water gas, is placed in an underground, concreted tunnel 4 ft. x 6 ft. in dimension. This gives unusually clear overhead in the mill buildings. The service lines are not only safe from ordinary damage but are located

FIG. 1. BENDING ROLLS AND PLATE TABLE; PULPIT IN THE BACKGROUND

[1] "Welding; Particularly Hammer Welding," CHEM. & MET. ENG., vol. 25, p. 553, Sept. 21, 1921.

[2] "Hammer-Welding Plant of the Blaw-Knox Co., CHEM. & MET. ENG., vol. 25, p. 747, Oct. 19, 1921.

so as to be readily accessible for inspection, alterations or repair. The ducts carry steam-heating lines, high- and low-pressure air and water, and the electric mains. Water gas, the fuel for the welding machines, is carried in a 24-in. main near the eaves, on the outside of the building. Producer gas for heating and annealing furnaces is conveyed from the gas house to the hammer-welding department by underground brick flues. These services are furnished by the power plants already installed for the other departments at Christy Park, except the water gas, which is generated in a separate unit, especially for the welding machines.

Heating and Bending Flat Plate

On entering the plant the first group of apparatus consists of charging machine, heating furnace, scarfing rolls, transfer table and bending rolls. The bending rolls themselves (Fig. 1) are exceedingly powerful, and can bend a cold 1-in. plate 21 ft. long into any cylinder down to 30 in. diameter. Consequently all but the very heaviest plates are placed directly upon the transfer table, and are led into the rolls.

A thicker plate would be placed upon the charging machine, which then moves to a correct position behind the heating furnaces. A set of chain-driven fingers slide the plate forward through the wide, low door of the heating furnace. The latter is quite similar to skelp-heating furnaces in use in other mills. It has a sand-covered flat hearth 17 x 23 ft. in area, with a low arching roof, and bordered on each side by a line of vertical ports. Regenerative checker chambers are built below the floor line on each side, so that producer gas can be used with considerable economy.

When the plate is judged to be ready for bending, it is pushed out of the front of the furnace by the charging machine, through the scarfing rolls, stopping on the plate table, on which it travels into the bending rolls. A temperature of 1,900 deg. F. is necessary, as the bending, which requires 5 minutes or more, must be completed before the temperature drops into the brittle range.

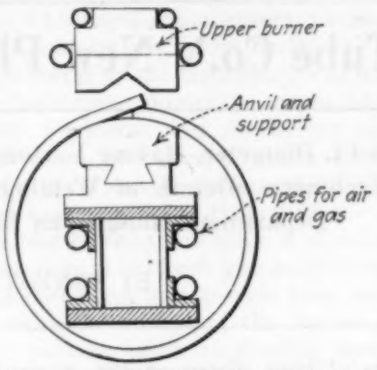


FIG. 4. CROSS-SECTION OF HORN, SHOWING RELATIVE LOCATION OF BEAM, ANVIL, GAS AND AIR PIPES, UPPER BURNER AND WORK

Once in the bending rolls, it is gripped by the bottom rolls and worked back and forth, passing through the stages shown in Fig. 2 and ending as shown in the left-hand sketch. Such work may be observed in many boiler shops; about the only difference is in degree; roll *B* forces the plate tight up to *A*, which is driven by a 175-hp. motor, so that the upper roll will not slip against the plate and fail to drive it over the side rolls *C* and *D*. Reaching the final stage, rolls *B*, *C* and *D* drop back to their lowest position, the end housing swings outward from a hinge near the floor line and frees roll *A*, which lifts up clear; the electric charging crane then removes the bent plate from the bending machine and deposits it on the carriage of the welding machine. All operations on this set of apparatus are controlled by one man from a pulpit.

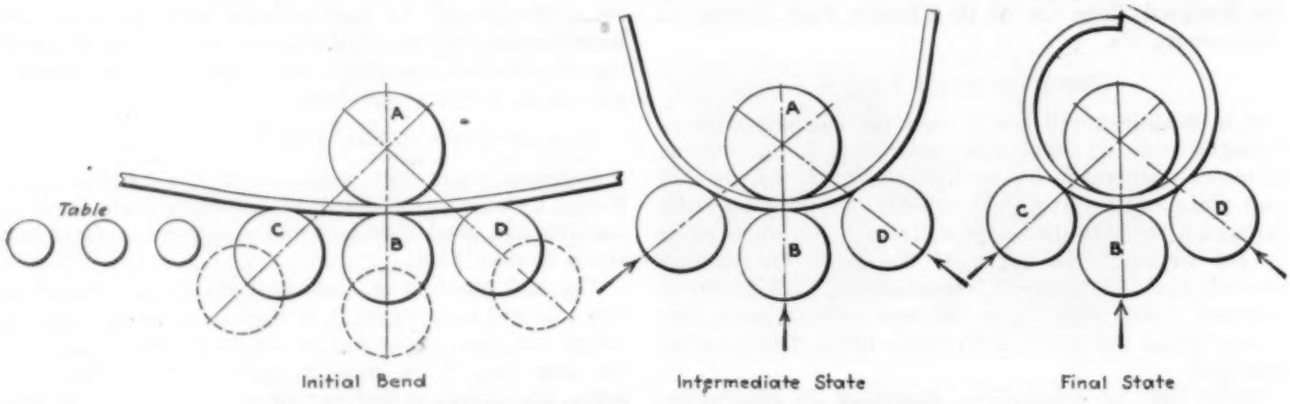


FIG. 2. THREE STAGES IN FORMING A CYLINDER FROM A FLAT PLATE

FIG. 3. WELDING MACHINES, WITH WORK IN PROGRESS

Welding Machines

Fig. 3 shows two welding machines, one designed for work up to 60 in. diameter, and the other for pipe from 48 in. to 96 in. diameter. Since the welding to be done on these units is confined to longitudinal seams on long cylinders, the carriage may be considerably simplified compared with one used for various seams on irregular shapes. It is mounted on a track so that it and its burden can move forward and backward over the anvil-bearing horn. The work rests on two sets of rollers, one forward pair and one rear pair. The beams bearing these rollers are capable of vertical movement, each pair independently, while the rollers are capable of transverse motion as well. If a weld is made on a tapered pipe, one of the roller sets is lowered a corresponding amount so the seam itself shall be horizontal

and on top. Controls are on the operating platform at the left side.

The anvil is keyed to the front end of a "horn," a heavily reinforced beam, about 12 in. deep and reaching forward about 22 ft. clear of its support (Fig. 4). The beam itself is considerably longer; it rests upon a heavy rocker bearing and extends backward, supporting a heavy counterweight. Thus the horn itself is relatively rigid and immovable; a hydraulic piston supports the counterweight at rest and raises and lowers the anvil slightly to clear small obstructions inside the unfinished pipe.

Since Fig. 4 shows that the anvil and horn just about fill the interior of the small pipes, the burners are mounted directly in front. Thus a certain area may be

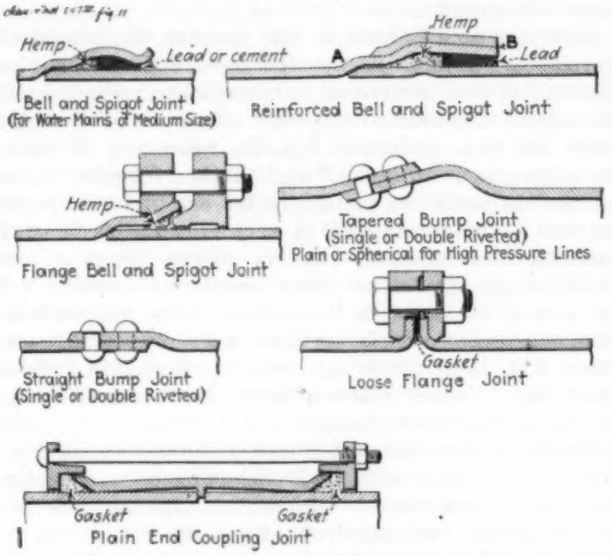


FIG. 5. VARIOUS STYLES OF JOINTS

heated, and the carriage moved in, bringing the hot portion directly over the anvil and under the air hammer, swung from a beam directly above. Gas and air pipes hug the side of the horn closely, and project past the anvil, being stiff enough to form the overhanging support for the lower burner. The upper burner is shown in Fig. 4; it can be raised and lowered at will in order to prevent fouling the work and to judge of the temperature of the metal being heated.

Water gas is the fuel. As noted in a previous article,[3] this gives a high temperature (1,900 deg. C.) and requires but 2¼ volumes of air for its perfect combustion. Thus it is relatively easy to get a quick and uniform mixture of air and gas without danger of forming heavy scale on the metal from the impingement of a poorly mixed stream of air and gas, portions of which would contain an excess of oxygen. All the gas lines are liberally supplied with traps or receivers, having explosion doors closed only with a rubber gasket. Each of the pipes leading to the burners is regulated by an ordinary one-way cock. These are adjusted by trial so that each pipe delivers the proper volume to its burner. Just beyond these cocks are gate valves, all operated simultaneously from the pulpit. A match thrown into the gas stream lights the burner for the first time; the incandescent brick is sufficient to ignite it thereafter.

Two men operate the machine; the welder, who controls the heat, the movement of the carriage, and the hammer. His assistant stands on the platform alongside the pipe, and with a clawbar, known as a "picker," rolls the pipe on its cradle as directed by the welder.

After adjusting the cradle rollers to the correct height, the carriage is moved forward over the horn, and any necessary blows struck alongside the seam to bend the flat edges[3] so that one side is sure to lap slightly under the other. Then, when a portion of the seam at its mid-length is laid down to the satisfaction of the foreman, he heats an area of metal there to the correct temperature, lifting the upper burner from time to time to judge the heat. Turning off the gas, the carriage moves forward so the hot spot is between anvil and hammer, and the welding is rapidly done. A few light blows stick the metal together and eject considerable liquid cinder. Air from the cylinder is exhausted against the seam directly below the hammer, blowing away loosened scale before it is driven into the hot metal. As the metal cools somewhat, the force of the blow is increased, and the lap is reduced to the thickness of the plate, continuing the work down to dull red, through recalescence. A few strokes on either side give correct bend to the portions of the pipe which could not be pinched in the bending rolls, a few more drive the unwelded seam just alongside into its proper position, and an adjoining portion is ready for heat.

The burners are 20 in. long, and heat an area about 2 ft. long by 16 in. wide, requiring, in ⅜-in. plate, between 40 seconds and 1 minute to bring to temperature. Shifting the carriage ahead is quickly done, and in 3 or 4 seconds the weld is being hammered. Perhaps 100 blows suffice to weld and shape 12 to 14 in. of seam, so that a complete cycle requires approximately 3 minutes. Thus a 20-ft. pipe can be welded from end to end in about an hour.

Specifications for Steel

Hammer welding is such a new departure that no definite requirements for the steel can yet be laid down. The American Society for Testing Materials[4] has adopted the following tentative specifications for open-hearth steel plates for hammer welding; the physical and chemical properties of the steel used at Christy Park conform to these requirements:

Carbon..... 0.18 max. (no 25 per cent excess allowed)
Mn..... 0.30 to 0.60
P..... 0.04 max.
S..... 0.05 max.
Preferably free of Si, Ni, Cr. Maximum 0.05 for any one.
Tensile strength: ¾-in. plate or thinner..48,000 lb. per sq.in. or more
Thicker plate .....45,000 lb. per sq.in. or more
Yield point, by drop of beam..... 0.5 tensile strength
Elongation in 8 in. (per cent).....1,500,000 ÷ tensile strength
(Less 1 per cent for each ⅛ in. above ¾ in., with a minimum of 20 per cent).
(Or less 2.5 per cent for each 1/32 in. below 5/16 in.).
Cold bend.....180 deg. flat upon itself without crack

Annealing is done in a regenerative furnace fired by producer gas. It is 10 ft. high by 12 ft. wide and 23 ft. long inside, with a row of vertical ports at each side. Its massive doors swing from the side, like garage doors, and are operated by hydraulic racks engaging pinions keyed to the hinge bolt.

The aim is to maintain this furnace at 1,650 deg. F. at all times. Bearing in mind the immense amount of reserve heat stored in the brickwork, it is apparent that it requires but a short time for a piece of ordinary thickness to acquire the annealing temperature, after which it is left to "soak" for 30 minutes. Thus each pipe is annealed singly immediately after welding is completed.

After this heat-treatment the doors are opened, the

[3] Plates up to 1 in. are welded without scarfing, by merely lapping over a distance approximately equal to one thickness and hammering down flat. Thicker plates are scarfed on their edges, bent to shape and welded.

[4] *Proceedings*, vol. 19, Part 1, p. 150. Specification A-78-21.

FIG. 6. MICROSTRUCTURE OF WELD IN UNSCARFED ⅜-IN. PLATE, PICKLED IN MIXED NITRIC AND SULPHURIC ACIDS

hot pipe is carried by crane immediately to the bending rolls. It requires but a few seconds to slip it around the top roll, adjust the end housing and lower rolls, when the whole pipe is rolled over and over to make sure the curvature is equal in all parts.

Tests on Welds

The pipe is now ready for the finishing operations. First it is mounted in a large lathe, having a bed 42 ft. long to accommodate sections made of two lengths welded together with a circumferential seam. Two separate carriages may be set the proper distance apart so that tools cut off each end simultaneously. These crop ends have been used to determine the relative efficiency of the weld. In a recent test of this kind, two transverse test-pieces were cut from the extreme outer edge and two adjacent to these or a few inches farther in, one pair representing the body of the plate and one pair containing the weld. These pieces were straightened cold and milled on four sides to give a smooth surface for a distance of 9 in. and then pulled in a testing machine. On the average, the first ring cut showed the outside weld to have 95 per cent of the strength of the weld a few inches farther in.

Averaging 120 tests taken from pipe which passed inspection and whose fractures actually occurred at the weld gives the following results:

	Metal	Weld
Yield point	31,390 lb. per sq.in.	29,260 lb. per sq.in.
Ultimate strength	53,690 lb. per sq.in.	49,480 lb. per sq.in.
Efficiency of joint (based on tensile strength)		92 per cent

One of the most interesting pieces of equipment is the flanging machine, used to expand, contract or flange —in fact, shape the end of the pipes into the many styles of joints which are specified for large conduits.

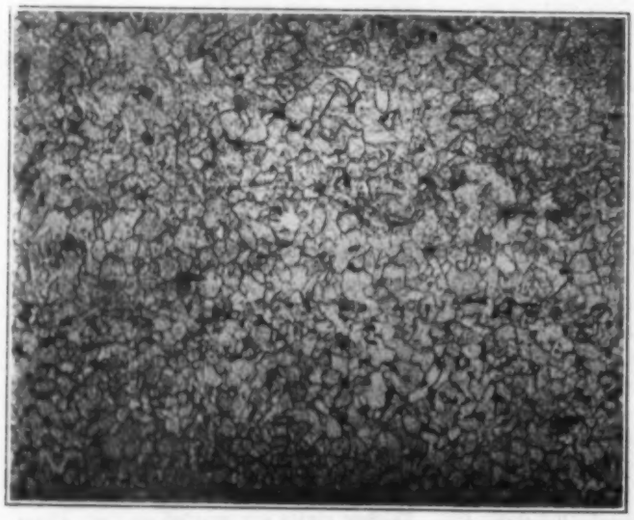


FIG. 7. MICROSTRUCTURE OF A GOOD WELD IN 30-IN. HAMMER-WELDED PIPE, MADE OF $\frac{1}{4}$-IN. PLATE

One end of the machine is a lathe headstock movable along the bed to adjust itself to different lengths of pipe and also to permit the necessary travel during its operation. A pipe is attached to the faceplate of this headstock, while the weight is carried by a steady-rest or set of idling rollers placed somewhat beyond the center of gravity.

After the pipe is fixed in this manner, the headstock travels to the left, placing the open end of the pipe directly between water-gas burners, adjustable to clear the outside diameter of the pipe. Rotation of the pipe heats the end uniformly for the necessary distance, when the gas is turned off and further forward movement of the headstock brings the hot end up to the forming tool. This consists of a very substantial housing inclosing the necessary motive power, gearing and adjusting screws for an upper and lower forming roll and a pair of idlers to the sides. These rollers have been machined so their surfaces have the contour desired, and they pinch against the hot pipe, which meanwhile is being rotated by the headstock, forming the end to the correct shape.

Testing is done in a huge hydraulic testing machine with 45-ft. reach and 2,500 lb. per sq.in. capacity. Since it is customary to subject all pipe to a 50 per cent overload, and penstocks have been built up to 1,400 lb. per sq.in. working pressure, this machine is expected to fulfill requirements of even the heaviest pipe. In routine testing, the metal at 50 per cent overload is seldom stressed over 15,000 lb. per sq.in., well within the elastic limit of the material.

Any necessary rivet holes are then made by drilling or punching, and the pipe is subject to a rigid final inspection for shape and general condition. (It is necessary to make large wrought pipe closely conforming to a true circle along its length, in order to present the maximum resistance to collapse against external pressure—caused either by water or earth on the outside or by vacuum on the inside.) After painting with the specified protective coating the pipe is ready for shipment.

Microscopy of the Weld

It is usually possible to determine the place where the joint has been made by a visual examination of a polished section after pickling with mixed nitric and sulphuric acid (Fig. 6), or after etching with a copper reagent. Deep etching digs a number of pits along the line of the weld where the acid attack is intensified. Microscopic examination usually reveals a small amount of oxide or slag inclusions along the line of the weld, although there will be stretches such as shown in Fig. 7, where none exist. Utter elimination of slag is perhaps impossible, but in a weld having 92 per cent strength they must be held to the extreme minimum. Sound welds properly annealed are characterized by the features shown in Fig. 7; a slight decarbonization in a very thin sheet, and a suggestion of columnar habit in the ferrite crystals occupying this region.

Determination of Volatile Matter in Coal

By H. P. Wilkinson, Jr.

THE value of the proximate analysis of bituminous coal to the engineer, coal dealer, power plant superintendent or coke plant superintendent is unquestioned. But there is always room for doubt as to how much can be predicted from this analysis concerning the behavior of the coal under consideration. This is especially true in the case of the coke-oven superintendent who expects the analysis to guide him in figuring the expected yield of his ovens. The ash and sulphur can be accurately determined by well-defined methods, and those tell him much about the quality of the coke. For the quantity, however, he must look to the volatile matter determination. At best this is an arbitrary figure, for regardless of the care exercised in taking, preparing and delivering the sample to the chemist it is practically impossible for two men working in different laboratories to obtain the same result. Assuming that the well-defined standard method is used, the results may be affected by the condition of the crucible, the style of cover used and the way it fits, the kind of burner and its condition, the kind of gas and the regulation of the flame, the possibility of mechanical losses due to the moisture passing off, and, greatest of all, the influence of the personal equation, which must be relatively great in any process having so many chances for error.

Considering it possible to overcome all these difficulties, the chemist's determination of volatile matter is still inadequate in predicting coke yield. It does not allow as much redeposition of carbon as occurs in the oven, due to the smallness of the sample and the size and shape of the space it occupies. Nor does it permit of any regulation of time or temperature, and these factors are both used in byproduct coke ovens, and have an influence on the amount of redeposited carbon, and thus on the amount of coke yielded.

The present outlook in the natural gas fields indicates a serious shortage, or even the complete exhaustion of the supply in a short time. This can be offset greatly by producing more coke-oven gas and there is a possibility that legislation may be enacted to restrict the burning of uncoked coal to those coals which are entirely unsuited for coking. This prospect for increasing activity in the manufacture of byproduct coke emphasizes the inadequacy of the present laboratory method for volatile matter, and creates a desire for a more reliable one—a method which will give data from which it is possible to predict the quantity and quality of coke yield. With a knowledge of this desire in mind, the writer conducted a series of experiments to evolve a method which will give a closer comparison between the volatile determination of the laboratory and the coking loss of the ovens.

Method Using Large Sample and Electric Furnace

The method finally settled on as being most satisfactory involves the use of an electric furnace with variable temperature, and a 100-g. sample. The furnace is of the resistance type and consists of a vertical cylinder 2 in. in diameter and 4 in. long inside. (A slight taper facilitates the removal of the coke.) This sits on a silica base and the junction of the base and cylinder are ground to make a joint which is practically air tight. The top fits just as closely and a clamp is provided to insure against leaks. Through the top are two holes, one into which a thermocouple is fitted and to the other is attached a tube for conducting the gases out of the laboratory.

In running a test the furnace is heated to the temperature of the ovens. The cover is then removed and the weighed 100-g. sample poured in quickly and the cover replaced and clamped. The coking is then allowed to proceed to completion, the time required being determined by the quality of the gas coming off through the outlet tube and varying with the temperature. The current is regulated during the coking to maintain uniform heating. When the coking is complete, the furnace is lifted from its base and the coke removed and quenched. It is then dried at 104 to 110 deg. C. and weighed, the weight in grams being the expected coke yield of the coal and the loss in weight the volatile matter.

Data Check Operating Results

In his experiments the writer used a number of coals and the work was repeated often enough on the various samples to prove that he was duplicating his own results. The samples were ground to pass through a 40-mesh sieve. The data listed below were obtained from the "general mixture" from the coal-handling plant of the Toledo Furnace Co. This gives more satisfactory results for publication, since the coke produced in the laboratory can be compared with the coke produced in ovens charged with the same coal. The analyses of this by the standard method and by the writer's methods are:

	Standard Method Per Cent	Writer's Method Per Cent
Volatile matter	32.94	28.12
Fixed carbon	59.54	64.36
Ash	7.52	7.52
Fixed carbon and ash	67.06	71.88

The average yield in dry coke of the ovens per ton of dry coal was 72.10 per cent. Thus it is readily seen that 28.12 per cent is practically the true coking loss and therefore the valuable volatile figure. To show how nearly the method reproduces oven conditions the analyses of the two cokes are given:

	Oven Coke Per Cent	Laboratory Coke Per Cent
Volatile matter	1.76	1.90
Fixed carbon	88.52	88.25
Ash	9.72	9.85

The fact that this method gives a volatile figure that compares so favorably with the coking loss of the ovens is no doubt due to the size of the sample and the regulation of the temperature. The size of the sample permits the hot gases to redeposit approximately the same amount of carbon that the oven does. This, coupled with the regulation of the temperature, accounts for the quality of the coke.

The writer believes that this method will be a welcome innovation to routine control laboratories, because it gives uniformly reliable data from which actual coking yield can be predicted.

Toledo, Ohio.

Bibliographies of Japan and China Available

Reading and reference bibliographies of Japan and China have been compiled by the Far Eastern Division of the Bureau of Foreign and Domestic Commerce, including books and periodicals pertaining to the history, constitution and politics, economic and commercial conditions, and life and customs of these two countries.

Legal Notes

By Wellington Gustin

Tank Agitation Patent Held Invalid as Not Being Invention

In a suit brought by Niel D. Nielson and another against Libby, McNeill & Libby for infringement of patents, the Federal District Court for the Northern District of Illinois held invalid the Nielson patents 1,268,601, claims 6, 7, 12-15, and 1,268,602, considering the state of the prior art, and rendered a decree for defendants.

These patents were granted to Nielson June 4, 1918, for improvements in "agitating means," being a means for agitating the contents of a tank, and specifically a vertical, cylindrical tank, by means of an agitator, preferably in the form of a wheel, resembling an ordinary screw propeller such as is used in driving boats, arranged upon the inner end of a shaft extending through the side of the vessel near its bottom.

The first patent shows a tank having the central portion of its bottom convex; the second patent shows a tank or vat with a concave bottom. Both patents in suit show tanks provided with jackets into which a heating or cooling medium may be introduced to vary the temperature, but this feature was not mentioned in any of the claims in issue.

Court Quotes Extensively From Decision Declaring Marchand Patent Invalid

In holding the claims as numbered above of the first patent and all the claims of the second patent invalid as not being invention from the knowledge of the prior art, the court referred to the U. S. Supreme Court decision in the case of Marchand vs. Emken, 132 U. S., 195, wherein the Marchand patent was held invalid in the following language:

"The pretence that the complainant had discovered some occult and wonder-working power in the motion of a screw revolving in the bottom of a tub is not sustained by the proof. Whether the contents of the tub be oxygenated water, or soap, or lye, or tartaric acid, the action will be the same. That rotary, eddying motions in liquid will result from the revolving screw, that the liquid will rise highest at the periphery of the tub and thus have the tendency at the top to fall toward the center were well-understood operations of centrifugal force. As every device, apparatus, formula, law of nature, motion and ingredient adopted by the complainant was old, the patent must be held invalid, unless it can be said that giving to oxygenated water a well-known rotary motion springs 'from that intuitive faculty of the mind put forth in the search for new results or new methods, creating what had not before existed, or bringing to light what lay hidden from vision.' . . . No such faculty has been tasked in giving form to this patent. There is here no sufficient foundation upon which to rest a claim which, if construed as broadly as the complainant insists it should be, practically makes all pay tribute who stir the mixture in question by machinery, and by hand also, provided substantially the same movement can be produced by hand stirring, and this seems to be a disputed question upon the proof. The complainant's claim to be enrolled upon the list of inventors is based upon propositions too theoretical and visionary for acceptance."

Laboratory Tests Cannot Outweigh the Test of Practical Use

A recent case in the Federal District Court for the Northern District of Illinois involved the Newberry patent, No. 851,347, for waterproofing portland cement by mixing therewith an insoluble salt of a fatty acid and no glycerine or other like water-attractive substance, and for the process for making the same. This same patent was involved in former litigation in McCormick Waterproofing Portland Cement Co. et al. vs. Medusa Concrete Waterproofing Co., 138 C. C. A., 14, where the Court of Appeals of the U. S. for the Seventh Circuit sustained a decree of the trial court holding the patent to be valid and infringed. In that case the court found that for forty years those skilled in the art had been aiming to overcome the attraction which concrete had for water. There it was said the capillarity of cement construction had been well known, and until Newberry came into the field nobody had offered anything like a practical solution of the difficulty.

Proof That Device Does Work Kills Expert Testimony That It Will Not Work

In this new attack upon the validity of this patent Dr. Gudeman was a new expert and it was attempted to show that laboratory tests determined that the Newberry process had no practical value. The court herein says that laboratory tests cannot turn the balance in the scale against practical use. The testimony of experts that a device will not work is of no value, if it does work. In the light of the practical use of this patent process the court assumed that Newberry discovered something worth while.

This action was brought by the Medusa Concrete Waterproofing Co. against the Ceresit Waterproofing Co. and others for infringement. The patent says to use an insoluble salt of a fatty acid and no glycerine or other like water-attractive substance, and it is mixed in small percentage with the cement. The defendant claimed that, because his product is in a paste, it does not come within the claims of the patent. Newberry recommends the drying of the product, although in the process of manufacture it is first in a wet or pasty shape of the defendant's product. But the patent says: "The resultant stearate of lime is to be dried, so that it is in the form of a dry powder."

Manner of Mixing the Only Difference in the Products in Question

Newberry testified that his product was made and sold both in the paste and the powdered form, but the demand in the powdered form was greater because it was more convenient to mix with the cement and other materials when in the form of powder. Mr. Miner, an expert witness, testified that the only difference in the two products of the competing companies was the manner of mixing the compound with the cement on the job; the Medusa powder being mixed with the dry material and the water added to the mixture, whereas the Ceresit is mixed with the water and in that form added to the dry material.

The court said the infringement was clear, and a decree was granted the plaintiff.

Enamel-Lined Apparatus

Plant of the Elyria Enameled Products Co. at Elyria, Ohio, Engages in the Manufacture of Enameled Equipment for Service in Many Varieties of Plant Processing—Steel and Cast-Iron Containers—Burning Equipment—Composition and Properties of Enamels—Control and Management of Operations

BY CHESTER H. JONES

WELL KNOWN to the industries producing a wide variety of substances for all markets where chemicals enter into the processes, ranging from the canning of fruits and vegetables, through acids and metallic compounds to dyestuffs and pharmaceuticals, the Elyria Enameled Products Co. at Elyria, Ohio, operates a plant of interest alike to chemical, ceramic and metallurgical engineers. The methods of manufacturing chemical plant equipment should be known, that the user may realize the limitations of mechanical design of ware and chemical resistance of enamel coatings. The modern methods of ceramic control in mixing ingredients and firing to the metal hold the attention of all ceramists. Metallurgists are interested in the best kind of metal for the purpose and in methods for making it better. Connecting the control of these operations in a scientific laboratory, the several branches are welded together to function through an ideal staff of technologists.

The photograph above, which was taken looking north, shows the entrance of the plant, with the laboratory building in the foreground and the office building on the left. Fig. 1 gives an idea of the building layout. Raw material in the form of steel plates grading in thickness from $\frac{3}{8}$ in. to $\frac{1}{4}$ in. is unloaded from cars at the north end of the tank shop. The rough castings for enameled cast-iron vessels are shipped in from the Sterling Foundry Co., a subsidiary corporation at Wellington, Ohio, and are stored in the large stock room shown near the cast-iron machine shop. Storage is

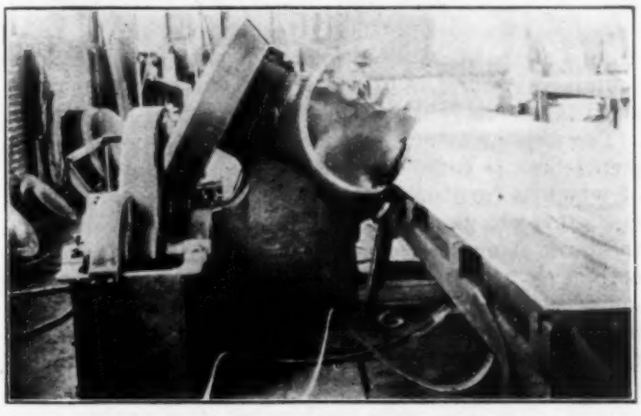


FIG. 2. SHEARING OPERATION

provided for 100,000 gal. of oil to be used as fuel for the furnaces. Oxyacetylene supply is furnished from Linde oxygen drawn from cylinders and acetylene made in the gas house in special carbide outfits, both separately piped to the welding stations about the plant.

Steam is supplied from two Erie City hand-fired boilers. The engine room has a 100-kw. Westinghouse direct-current 220-volt generator direct-driven by an Erie City engine. One Ingersoll-Rand two-stage steam-driven compressor furnishes air at 90 lb. pressure for air hammers and enamel spraying outfits, while another produces 40 lb. air for the sand-blast plant. Feedwater for the boilers is heated in an open type Swartout feed-water heater.

The auxiliary mechanical department apart from the process operations is completed by an electrical shop

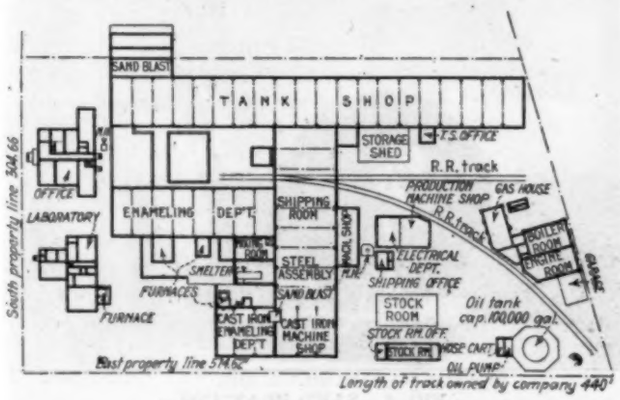


FIG. 1. BUILDING LAYOUT

FIG. 3. WELDING STEEL TANKS

and production or repair machine shop. This latter shop is equipped with lathes and drill presses for light machine and electrical repairs.

The steel plate enters the north end of the long tank shop (Fig. 1), where it is handled throughout the work by two overhead traveling cranes, one Toledo and one Morgan. The operations in this room consist of laying out, cutting and trimming, rolling and welding. Fig. 2 is a view of the shearing operation, where a bevel shear is trimming the plate to size. From this machine the plate continues to the Cleveland rolls, in the background of the same view, where the side of the circular container is formed to required radius. Bottoms for large tanks are kept in stock.

The welding of steel sections to form the rough completed tank is carried on at twenty-four stations, each of which is furnished with a No. 8 low-pressure torch. Operators use gloves and special goggles. Fig. 3 shows the work of making a joint at the junction of a convex bottom on a cylindrical tank. At the Columbus meeting of the American Ceramic Society Emerson P. Poste, director of research, presented a paper which shows the quality of steel obtained at these welds when the metal undergoes heat-treatment incidental to the firing of the enamel onto the ware, enhancing the quality and strength.

The surplus metal on the inside of the tank is ground off after welding by portable electric grinders made by the Heisey Wolff Co., of Cincinnati, and Van Dorn Electric Co., of Cleveland. The completely constructed tanks enter the sand-blast compartments.

The equipment for cleaning the surface to be enameled by sand blast consists of four Paxon units and according to the superintendent represents the "last word" in sand-blast machinery design. Coarse sand falls from steel storage hoppers into the sand-blast machines, where, mixing with the 90-lb. air supply, it is forced through armored hose to the operator's nozzle. Fig. 4 shows the operator applying the stream of sand to the inside of a tank. Protection is afforded him by a respirator and helmet which is fed with compressed air.

The sand from this operation falls through the steel grid floor and is elevated to a rotary screen separator. The head of one of the sand elevators with drive appears on the balcony in Fig. 4. The coarser particles fall back to storage for the next operation, while the fine dust is carried to four dust separators resembling baghouses. Circulation through this system is obtained by four Sturtevant exhausters driven by 20-hp. motors. The fines from the baghouses are rejected. All motors and switch boxes are totally inclosed to protect from dust. The steel containers are next transferred by industrial cars to the enameling department.

The mixing, smelting and grinding of the materials which go to make up the enamels for both the steel and cast-iron pieces is carried on in the mixing room and smelter, shown adjacent to the enameling department in Fig. 1. Typical formulas are given in the accompanying tables reprinted from the *Journal of the American Ceramic Society*, vol. 2, No. 12, December, 1919. The term "ground coat" in these tables refers to the first coat applied to the cleaned metal, while "cover coat" is applied over the ground coat to give finished appearance to the ware.

After mixing by hand or rotary mixer the raw batch is introduced into the oil-fired smelting furnace appearing in Fig. 5. This is essentially a reverberatory furnace and the operator is seen rabbling the mix. A rotating U. S. furnace is also employed for the same work. When the fusion is uniform, the molten glass is tapped and run into a vessel of cold water to produce the shattered frit. In the case of one type of cast-iron ground coat the smelting process is varied by placing the thoroughly mixed batch on a cast-iron tray, heating to a red heat and stirring at intervals. The resultant product from this sintering operation resembles pumice stone.

Wet grinding of the frit is in general used for sheet

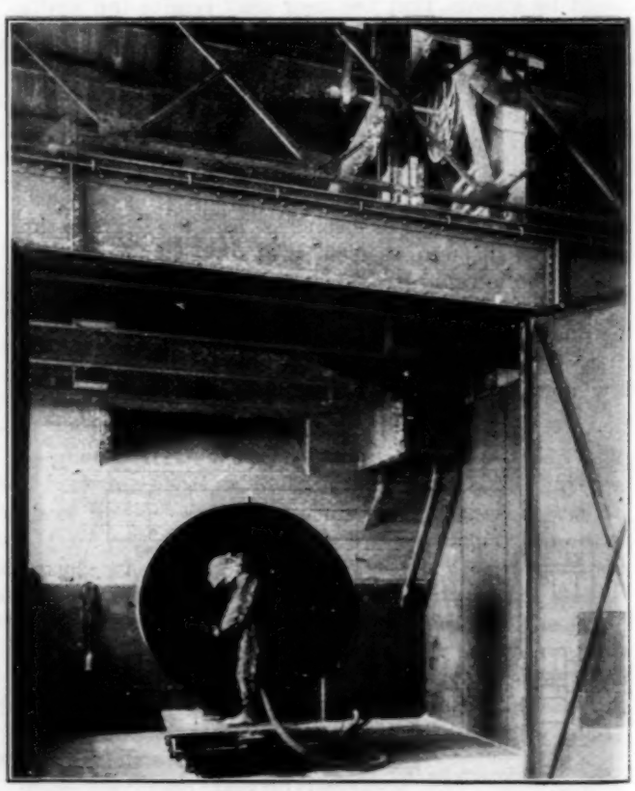


FIG. 4. SAND BLASTING

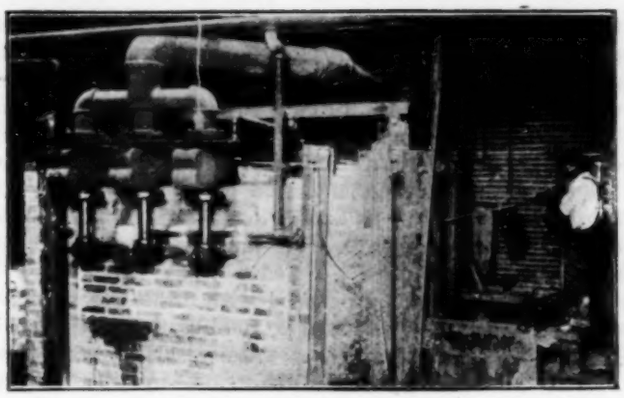


FIG. 5. SMELTING FURNACE

steel enamels and cast-iron ground coats and dry grinding for cast-iron cover coats. The grinding room equipment includes one 1,000-lb. Abbe and one 1,000-lb. Patterson pebble mills, three 200-lb. Abbe, one 100-lb. Patterson and one 50-lb. Abbe pebble mills. Four of these mills are seen in Fig. 6.

Dry grinding simply consists of pulverizing the frit to a dust for direct application to the ware.

In wet grinding the mill additions consist of various materials introduced with the frit and water to hold the frit in suspension and form a creamy liquid suitable for spraying on the metal. According to R. R. Danielson, U. S. Bureau of Standards, in milling the ground coats it is general practice to add high-grade ball clay and water to the frit at the beginning of the operation and to add the borax in hot solution about one-half hour preceding the end of the operation. Magnesium carbonate and ball clay with small amounts (about 0.25 per cent) of an electrolyte such as magnesium sulphate or cobalt and nickel sulphates may be used for mill additions to cover coats. Typical mill additions are also shown in the tables.

BATCH FORMULAS

Raw Materials	No. 1 Steel Ground Coat [a]	No. 2 Steel Cover, White [b]	No. 3 Cast-Iron Ground Coat	No. 4 Cast-Iron Cover, White [c]
Soda	74	...	...	71
Borax	356	154	288	133
Saltpeter	....	65	16	...
Chilean saltpeter	....	...	...	24
Lead oxide	....	...	...	144
Zinc oxide	....	...	...	44
Tin oxide	....	...	...	73
Calcspar	....	65	...	24
Barium carbonate	....	...	...	11
Magnesium carbonate	....	10	...	...
Feldspar	363	386	...	372
Fluorspar	53	13	...	107
Cryolite	....	117	...	...
Quartz	144	190	700	...
Manganese dioxide	6½	...	...	...
Cobalt oxide	2¼	...	...	...
Mill additions	6% clay 2.5% borax	12% tin oxide 7% clay 1% Mg oxide	9% sand 12% clay	None

[a] *Trans.* Am. Ceram. Soc., Vol. 14, p. 759 (1912.)
[b] *Ibid.*, Vol. 14, p. 498 (1912).
[c] *Ibid.* Vol. 15, p. 622 (1913).

MOLECULAR FORMULAS

	No. 1 Steel Ground Coat	No. 2 Steel Cover, White	No. 3 Cast-Iron Ground Coat	No. 4 Cast-Iron Cover, White
Na_2O	0.64	0.50	.....	0.30
K_2O	0.08	0.18	.....	0.09
CaO	0.24	0.28	.....	0.35
BaO	....	....	.....	0.01
MgO	....	0.04	.....	....
PbO	....	....	.....	0.13
ZnO	....	....	.....	0.12
MnO	0.03	....	.....	....
CoO	0.01	....	.....	....
Al_2O_3	0.20	0.30	.....	0.15
SiO_2	2.26	2.51	.....	0.86
B_2O_3	0.63	0.26	.....	0.15
F_2	0.23	0.60	.....	0.30
SnO_2	....	....	.....	0.10

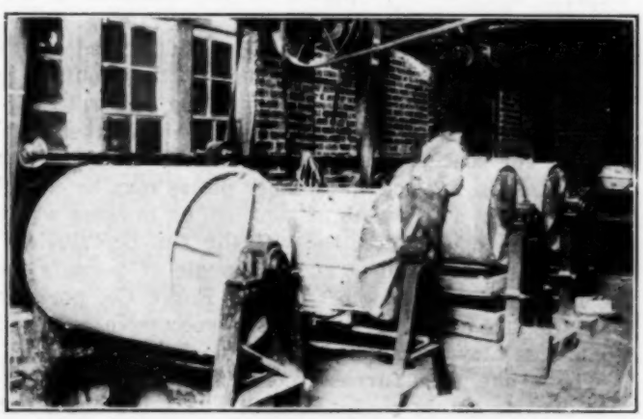


FIG. 6. GRINDING MILLS

FIG. 7. APPLYING ENAMEL TO STEEL

While accurate data on the properties of enamels from the standpoint of chemical operations can be obtained only by submitting the particular process or essential conditions under which the enameled ware is to be used to the research laboratory, nevertheless the company makes three general grades some of the uses of which are outlined in the following paragraphs.

Enamel No. 11, which is applied to cast-iron ware, has been found to resist the action of inorganic acids such as hydrochloric, nitric, phosphoric, sulphuric, hydrobromic, hydriodic, aqua regia at any strengths and any mixtures of these. It is acted upon by hydrofluoric acid of any strength. It resists reactions of stannic chloride in hydrochloric acid, zinc chloride up to 300 deg. C., gaseous hydrochloric acid, aluminum chloride, bromine, chlorine, iodine (moist or dry), tungstic oxide precipitation by hydrochloric and nitric, sulphur dioxide, thorium nitrate in nitric acid, and manganese dioxide with hydrochloric acid. It may be

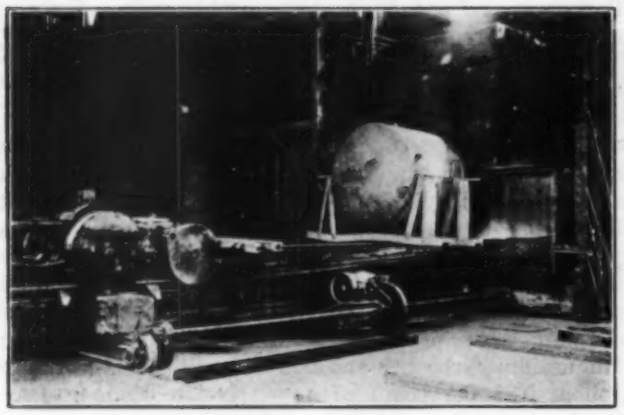


FIG. 8. STEEL ENAMEL FURNACES

used for all organic acids, acid chlorides and organic compounds, being particularly resistant to acetic vapors.

It is successful in vessels for heating magnesium hydroxide under pressure, for evaporating lime salts of sulphocarbolates or boiling sodium carbonate, for ammonia and sodium or potassium salts of inorganic compounds, but is decomposed by caustic alkalis and is acted upon slightly by hot milk of lime. Sodium cyanide and similar salts are too alkaline and react with it. It is more resistant to alkalis than most enamels.

Enamel No. 20, which is applied to steel, has been used successfully for all strengths of organic acids (hot or cold), ammonium sulphate, acetic anhydride, acetic acid of all strengths, (but not the vapors), brine, moist chlorine, hydrochloric acid in alcohol, hydriodic acid, lactic acid of all strengths (hot or cold), hot phenol, tin chloride plus 1 per cent hydrochloric acid, zinc chloride solution, hot sulphur chloride, inorganic acids below 0.5 per cent strength cold, sulphuric acid above 50 per cent strength and mixed acids high in sulphuric acid, hot or cold. If the reagent is one which attacks iron severely, the enamel coat must be perfect, limiting the size to 600 gal. If there is no severe action on iron, any size up to 3,000 gal. can be had. The limiting size must be decided for each condition by itself. It is also used for hot carbonate, cold sodium hydroxide 10 per cent and hot ammonia.

Enamel No. 21, which is also applied to steel, is used for all conditions of milk, such as milk heating, holding, mixing, etc.; for oils, fats, alcoholic solutions of shellac, ammonia, aniline hydrochloride, acetic acid, storage cold; ammonium nitrate, bleach liquor, dry chlorine, dry hydrochloric acid gas, cold beverage sirups involving citric acid, grape juice, hydrogen peroxide,

FIG. 9. ASSEMBLING ENAMELED STEEL APPARATUS

tincture of iodine, making invert sugar, hot oil of peppermint, cold phenol, salicylic acid and hot acetic anhydride, dry sulphur dioxide, tannic acid, hot bromine, distilled water, and hot fuming sulphuric. The last has been handled more successfully by No. 21 than by other enamels. For perfect coats the sizes are limited to 1,000 gal. Otherwise any size up to 7,000 gal. can be obtained. Here, as with No. 20, the limiting size can be determined only after making a study of the case in hand.

Cast-iron units may be used with 75-lb. steam pressure in the jacket and up to 100 lb. inside the still. It has a coefficient of heat transmission about one-fourth that of copper. With steam, temperature up to 160 deg. C. in the jacket can be obtained. Up to 225 deg. C. an oil jacket can be used. Superheated steam at 315 deg. C. has been used on the small units. The enameled units have also been heated by a direct, well-spread flame up to temperatures of 300 deg. C., but such service is rather severe, limiting the life of the enamel.

Steel units are usually heated by means of a steam jacket, the 500-gal. sizes permitting 30-lb. pressure, the

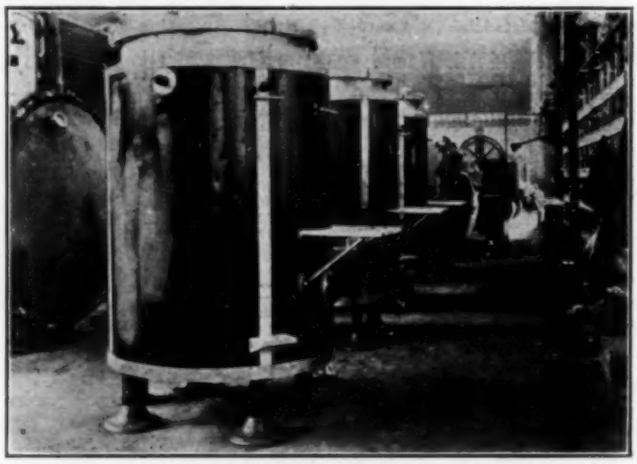


FIG. 10. ENAMELED STEEL APPARATUS READY FOR INSPECTION AND TEST

large ones, such as 3,000 gal., being limited to 10-lb. pressure. The pressure within the tank may be one and a half times as great as that in the jacket. The coefficient of heat transmission is about one-third that of copper, using straw as a heating medium. Using oil in the jacket (which has been done up to 250 deg. C.), the coefficient drops to one-fifth that of copper.

The wet enamel from the mill room is stored in containers, whence it is drawn to the compressed air-spraying machines made by the De Vilbis, Toledo, Ohio, and the Paasche Co., Chicago, and located in the enameling room. Fig. 7 shows one of these outfits in operation on a steel tank, the spraying apparatus appearing on the left of the view. This is the usual method for coating the steel containers. They receive from three to five coats. Smaller pieces may be coated by dipping in a large tub of solution, or in cases where only one side is coated, the wet slip can be "slushed" over the surface held at such an angle as permits the excess to be drained off. Buffalo Forge Co. portable blowers are used for drying the successive coats of enamel as they are applied.

The steel enamel furnace room adjacent to the spraying department is equipped with one 6-ft., one 10-ft. and one 14-ft. furnaces, all constructed from firebrick

and of the open type with flame introduced from below. The largest furnace has hydraulic lifts for operating the doors, which part on a horizontal center line, saving time on the opening and closing movements. The burning temperature varies between 1,800 and 2,200 deg. F.

Fig. 8 is a view along the front of the three steel enamel furnaces, with the largest in the foreground. The charging machine, shown loaded with a piece ready to enter the large furnace, is manufactured by the Morgan Engineering Co., Alliance, Ohio. Each one of these machines is equipped with three electric motors, permitting movement of the piece in any one of three directions. The electrical controllers are operated in a pulpit to the rear of each machine.

One Morgan 5-ton overhead electric crane operates the length of the enameling department and along the front of the furnaces for moving the pieces about the enameling floor and placing them on the charging machines.

Oil is used for fuel in the steel-enameling furnaces and is burned by the General Combustion Co. oil-gas system. The blower equipment in this system consists of one 50/60-hp. electric-driven unit delivering 4,200

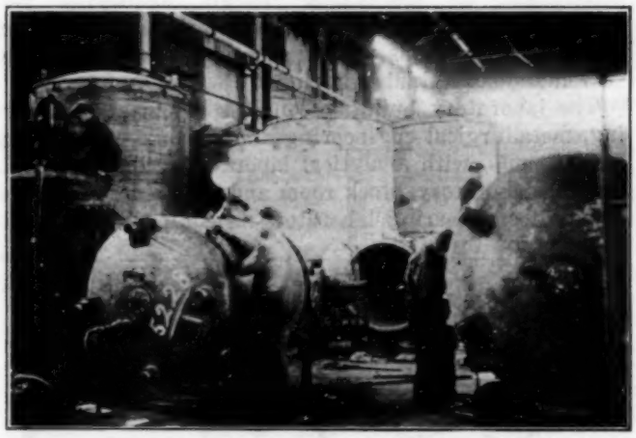


FIG. 11. ENAMELED STEEL APPARATUS UNDER TEST

cu.ft. of free air per minute and one 20-hp. electric unit with a 2,500-cu.ft. capacity, both pressures approximating 3 lb. Motors and blowers are manufactured by the General Electric Co. Brown Instrument Co. pyrometers record the burning chamber temperatures.

The first action on placing the coated ware in the furnace consists of dehydration of the clay and other mill additions which in drying have still retained moisture. The individual particles of the coat then melt and run together, giving an even distribution of glass over the whole surface. After the ground coat has been processed, the operation is repeated with the cover coats until the required surface is produced. All burning operations are carried on in an oxidizing atmosphere.

The steel assembly building, housing the assembling operations and shipping room, with the cast-iron machine shop at the east end, is 170 ft. long and has a Toledo electric crane with 36 ft. clearance operating its entire length. As the enameled pieces are conveyed from the enamel department to the assembly department, those requiring steel jackets are built up by oxyacetylene welders near the point of entrance. Other parts, such as motors, agitators, brackets and pipe fittings, are attached until the required unit is finished and is then finally painted. Fig 9 shows a series of operations of this nature. Fig. 10 is a view of com-

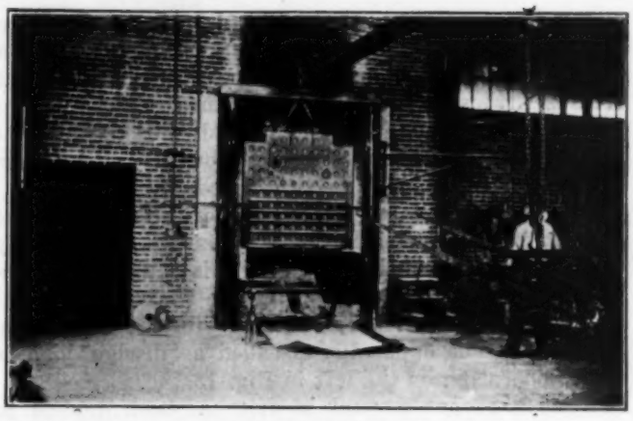


FIG. 12. CAST-IRON ENAMELING FURNACE

pleted units ready for inspection and test and Fig. 11 some of the units under test. The piece on the left of Fig. 11 is undergoing pressure test on the jacket.

The assembly machine shop adjoins the main building on the north and is furnished with lathes, drill presses and all other machine tools needed in the building up of the small parts for complete units. As noted, the cast-iron preparation room occupies the east end of the assembly building. Here all the rough castings are made ready for the enameling operations and later returned for additional machining required for assembly.

This department employs large boring mills, lathes and shapers for complete production. A small Paxon sand-blast equipment, similar to the units at the tank shop, operates in connection with this room and for use in cleaning surfaces to be enameled.

The cast-iron department enameling equipment, adjoining the machine shop, consists of one 4-ft. coal-fired muffle furnace and one 7-ft. Dutch oven furnace built by L. W. Manion, Canton, Ohio, using refractories from the Massillon Stone & Firebrick Co., Massillon, Ohio. Fig. 12 shows the front of the former with charging machine ready for operation.

The dry process of enameling is used largely for the cover coat on cast iron where the pulverized frit is dusted onto the piece and melted to an even surface. This gives the best enamel for resisting acids, being particularly high in silica. The absence of mill additions in the form of clay and electrolytes assures the intimate contact of particles of the dry frit to produce a true glass coating.

The dry powder is seen in a pan on the floor (Fig.

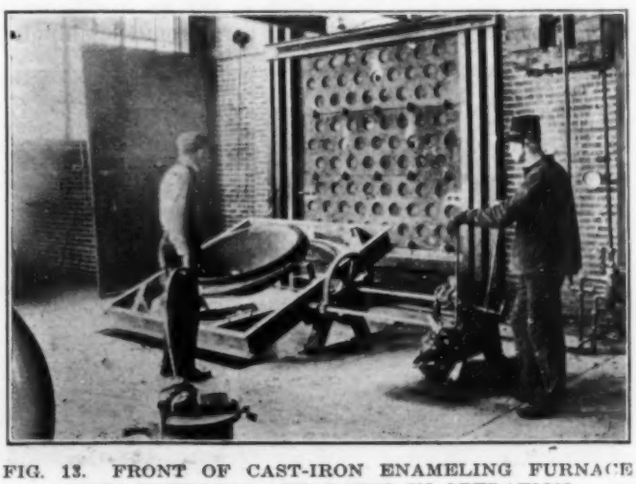


FIG. 13. FRONT OF CAST-IRON ENAMELING FURNACE WITH DREDGING APPARATUS IN OPERATION

12) ready for dusting onto the piece balanced above. Fig. 13 is the front of the 7-ft. furnace with the dredging apparatus in operation. The wet ground coat is first sprayed onto the cleaned surface in the usual manner, and after thorough drying the piece is placed in the muffle furnace and brought to a uniform temperature approaching a bright red.

Upon removal, the ware is not permitted to cool as in the case of steel enameling, but is immediately dusted with the dry frit powder. This is usually accomplished by placing powder in a sieve shaken by a compressed air or electrically operated vibrator held above the piece. The apparatus is called a "dredge" and is shown operating on the left in Fig. 13.

When a proper amount of frit has been applied to the revolving piece, it is run back into the furnace on

FIG. 14. ASSEMBLING ENAMELED CAST-IRON APPARATUS

forks and permitted to come to sufficient temperature to fuse the coat. The piece is again withdrawn and the operation is repeated, continuing with these cycles until the required thickness of glass is built up. The final firing is somewhat harder than the previous ones, resulting in a smooth surface and high gloss.

With the enameling operation completed, the thoroughly cooled ware is returned to the machine shop and assembly room, where it undergoes operations similar to the steel assembly. The complete apparatus may range from unjacketed open-top dishes to jacketed vacuum pans with agitator and other accessories. Fig. 14 shows some of the cast-iron units in process on the assembly floor.

It will be noted by reference to Fig. 1 that the shipping tracks are very well and simply located, entering the center of the plant in such a way as to discharge raw material and receive loaded cars from the shipping

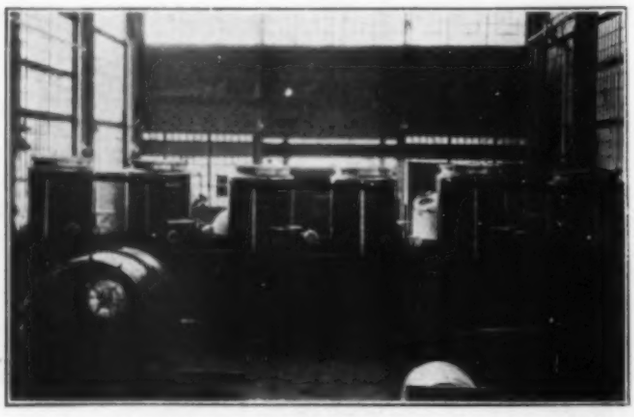


FIG. 15. ENAMELED APPARATUS LOADED FOR SHIPMENT

FIG. 16. INTERIOR OF SUPERINTENDENT'S OFFICE

section in the assembly building. Fig. 15 shows a car at this location ready for shipment. Some of the smaller orders and express shipments are handled to railroad shipping platforms by Packard trucks.

The business control of the factory is handled from the factory manager's and superintendent's office, interior view of which appears in Fig. 16, and the department of mechanical design, employing two mechanical engineers and several draftsmen, as seen in Fig. 17, functions with the necessary aid of the research and control laboratories.

The laboratory building contains chemical engineering, metallurgical engineering and ceramic engineering departments, with analytical laboratory, chemical engineering laboratory, stock room and first aid room. The chemical engineering laboratory is equipped with cast-

FIG. 17. DRAFTING ROOM

iron and steel vacuum pans and condensers. The work here is chiefly concerned with the development of apparatus for adaptation to new lines of industry and investigation in connection with chemical inquiries.

The ceramic engineering department has to do with factory control and research on enamel. The apparatus for this work includes refractometer, petrographic microscope, Freas oven and Hoskins electric furnace. The furnace room has an experimental pot smelter, Abbe pebble mills, an experimental commercial furnace and other equipment for carrying out research on an industrial scale. The metallurgical engineering section deals largely with the quality of steel and cast iron used and the effect of various enameling processes upon them. A completely furnished microphotographic room operates in connection.

The laboratory work will be described in a subsequent issue of CHEMICAL & METALLURGICAL ENGINEERING.

Recent Chemical & Metallurgical Patents

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Mono-azo Dyes.—Mono-azo dyes are obtained by coupling 4-nitraniline-2-sulphonamide (in which one or both hydrogen atoms of the sulphonamide group are replaced by alkyl, aryl or aralkyl) with a 2-naphthylamine sulphonic acid or a 2-amino-8-naphthol sulphonic acid, or a derivative thereof, in acid solution. As diazo components are mentioned 4-nitraniline-2-sulpho-ethylanilide, 4-nitraniline-2-sulphanilide, 4-nitraniline - 2-sulphodiphenylamide, 4-nitraniline-2-sulphomethylanilide, 4-nitraniline-2-sulphomethylamide, 4-nitraniline-2-sulphomethyl-o-toluidide, 4-nitraniline - 2 - sulphopiperidide; as second components, 2-amino-8-naphthol-6-sulphonic acid, 2-methylamino-8-naphthol-6-sulphonic acid, 2-methylamino-8-naphthol-6-sulphonic acid, 2-naphthylamine-8-sulphonic acid, 2-naphthylamine-6:8-disulphonic acid, o-anisyl-2-naphthylamine-8-sulphonic acid. The products may be reduced with alkaline reducing agents. According to one example, diazotized 4-nitraniline-2-sulpho-ethylanilide is coupled with 2-amino-8-naphthol-6-sulphonic acid in glacial acetic acid solution yielding a navy-blue wool dye; in a second example the solution obtained by effecting the same combination in weak mineral acid solution is reduced by sodium sulphide giving a bluish wool dye. (Br. Pat. 164,218. Farbenfabriken vorm. F. Bayer & Co., Leverkusen, Germany. July 27, 1921.)

Dyes; Intermediate Products.—Indigoid vat dyes are obtained by condensing a halogenated isatin (in which the α-ketonic oxygen is replaced by a substituent such as halogen, sulphur, the anilido-group, etc.) with 1-oxy-6-naphthol ether or a halogen substitution product thereof, or with 1:6 dioxynaphthalene followed by alkylation or aralkylation; the products may be further halogenated. The dyestuffs obtained from 5:7 dichlorisatin α-chloride and 1-oxy-6 naphthol ether dyes cotton grayish blue to black shades, or, after chlorinating, black shades, from a hydrosulphite vat; that from dibrom-β-naphthisatin chloride and 1-oxy-6 naphthol ether dyes fast olive green shades; that from 1-chloro- or bromo-2:3-naphthisatin chloride and 1-oxy-6-naphthol ether dyes greenish gray; that from 5:7 dibromisatin-α-chloride and chloro-1-oxy-6-naphthol ether dyes grayish blue; 1-oxy-6-naphthol ethers are obtained by acetylating 1-amino-6-naphthol, alkylating the -OH group, removing the acetyl group and replacing the amino group by the hydroxy group in the usual manner. Chlor-1-oxy-6-naphthol ethers are obtained by chlorinating 1-oxy-6-naphthol ethers with SO_2Cl_2 in glacial actic solution. Brom-1-oxy-6-naphthol ethers may be prepared by brominating the carbonate of 1-oxy-6-naphthol ether and then splitting off the carbonate group. (Br. Pat. 164,594. Farbenfabriken vorm. F. Bayer & Co., Leverkusen, Germany. Aug. 4, 1921.)

Alloys Containing Alkaline Earth Metals.—Alloys containing one or more alkaline earth metals are made by the reaction of an alloy containing an alkali metal or metals and one or more halogen salts of the alkaline earth metal or metals, mixed or not with other salts, the materials being maintained in a highly fluid state during the reaction. The salts used may include double or multiple salts, mixtures of different alkaline earth salts, salts of other metals which are capable of replacing the alkali metal in the alkali metal alloy such as aluminum, cadmium, copper, zinc, lead and bismuth, or salts of metals inert to the alkali metal in the alloy, such as sodium. If the metal which is to be alloyed with the alkaline earth metal does not alloy with an alkali metal, mechanical mixtures of the metals and alkali metal may be used. The salts may be present in large excess of the theoretical amount—for example 2 to 5 times—and may be heated considerably above their melting point. In some cases the alkali-metal alloy or the molten salt or both may be maintained in motion during the reaction—for example by a counter-current method—or by causing the materials to impinge on each other, and the molten salt may be renewed during the process of substitution. The production of the following alloys is referred to: lead and calcium; lead and barium; lead, calcium and barium; lead, calcium and magnesium; lead, barium and magnesium; aluminum and magnesium; aluminum and beryllium; copper, calcium and boron; lead, manganese and barium; copper, aluminum and calcium. (Br. Pat. 164,608. G. J. Kroll, Luxemburg. Aug. 4, 1921.)

Phthalic Acid and Anhydride.—Phthalic acid or its anhydride are prepared by treating naphthalene vapor with air or other oxygen-containing gas in the presence of a small amount of vanadyl chloride at 300 to 650 deg. C. The mixture of naphthalene vapor, air and vanadyl chloride vapor is passed through a vessel or tube, empty or containing pumice, firebrick, kieselguhr, etc., and the products condensed in cooling chambers. In place of naphthalene other volatile hydrocarbons or their derivatives yielding phythalic acid on oxidation, such as α- or β-methylnaphthalene, tetrahydronaphthalene, α-naphthol, or o-xylene, may be used. (Br. Pat. 164,785. British Dyestuffs Corporation, Ltd., London A. G. Green, Hale, Cheshire, and J. W. Porter, Belfast. Aug. 10, 1921.)

Sodium Formate.—Sodium formate is produced by introducing carbon monoxide into water containing sodium sulphate and lime, the sodium sulphate being maintained at a concentration not greater than 7 per cent calculated as Na_2SO_4. This concentration may be regulated by the presence of basic sodium calcium sulphate, $Na_4Ca_2(SO_4)_4(OH)_2$, obtained by heating calcium or sodium hydroxide in water with sodium sulphate and calcium sulphate, or with substances containing or forming these compounds—e.g., calcium sodium sulphate or sodium chloride and calcium sulphate. Another method of maintaining the sodium sulphate concentration consists in adding sodium sulphate or calcium sodium sulphate or basic sodium calcium sulphate to replace the sulphate as it is consumed, excess of lime being either present in the reaction vessel or gradually added thereto. (Br. Pat. 165,163. M. Enverli, Oestrich, Rheingau, Germany. Aug. 17, 1921.)

Phenol-Aldehyde Resins.—Resins are obtained by condensing the *ar*-tetrahydronaphthol or mixture of *ar*-tetrahydronaphthols, obtained by alkali fusion from technical tetrahydronaphthalene sulphonic acid, with an aldehyde with or without the aid of a condensing agent; the resins may be rendered fast to light by treatment with acidylating, alkylating or aralkylating agents. According to examples, *ar*-tetrahydronaphthol and 30 per cent formaldehyde are boiled together, or heated in an autoclave to 110-115 deg. C.; or heated to 60-70 deg. C. in the presence of a little hydrochloric acid, ammonium chloride or potassium hydroxide, and the resulting viscous products washed and dried; these products are further treated with acetic anhydride, or with ethyl bromide and caustic potash. In other examples acetaldehyde is employed and the resins obtained heated with benzoic anhydride. For formaldehyde and acetaldehyde may be substituted their polymers or substances which form an aldehyde. The products are clear brittle masses, soluble in alcohol, benzene, dichlorbenzene, linseed oil and turpentine. (Br. Pat. 165,322. Akt. Ges. för Anilin-Fabrikation, Berlin. Aug. 17, 1921.)

Separating Nitrogen Oxides in a Mixture of Gases.—Nitrogen oxides are absorbed from dry gaseous mixtures by substances other than alumina which are capable of forming addition products at temperatures between 0 and —80 deg. C. and of liberating the nitrogen oxides again at a higher temperature, generally about 100 deg. C. The substances mentioned as suitable are ferric chloride, calcium, magnesium, copper, zinc and iron oxides, and certain aluminous products, such as dehydrated bauxite. The essential condition to be observed in order that these substances may absorb the nitrogen oxides is that the substances are obtained or dehydrated at low temperature. The heating to liberate the nitrogen oxides may be effected in a partial vacuum. (Br. Pat. 166,095; not yet accepted. Société Anonyme L'Azote Français, Paris. Aug. 31, 1921.)

Current Events
in the Chemical and Metallurgical Industries

More Plants Resuming Operations

Paper.—The Bryant Paper Co., specializing in the production of book papers, has resumed operations at a capacity basis, following a curtailment for about 12 months past. The plant will run on a 24-hour schedule, giving employment to about 1,200 operatives.

The American Strawboard Co., Noblesville, Ind., has resumed production with a full working force, and all departments are operating. The plant has been idle for some time past.

The Eastern Manufacturing Co., Bangor, Me., is now operating at full capacity in its pulp department, following production on about a 50 per cent basis for some months. The paper mills of the company are also running full.

Oil.—The Sinclair Oil Co., Muskogee, Okla., has resumed operations at its local refinery, following a shut-down for the past two months.

Copper.—The International Smelting Co. is arranging to blow in one reverberatory furnace at its Miami, Ariz., smelting plant on Nov. 20, following a suspension of operations for the past six months.

Sugar.—The Owosso Sugar Co., Owosso, Mich., has opened its plant at Lansing, Mich., giving employment to about 300 men.

The Mount Pleasant Sugar Co., Lansing, Mich., has commenced production at its mills with a working force of over 250 men.

Iron.—The Reading Iron Co. placed its Keystone blast furnace in operation on Nov. 1, following a suspension from Nov. 15, 1920.

The Carnegie Steel Co., Pittsburgh, Pa., has lighted another furnace at its New Castle, Pa., plant, increasing operations to about 75 per cent of normal. About 200 additional men will be employed at once.

The Bethlehem Steel Co., Bethlehem, Pa., has recently resumed operation of its Furnace D, making two units now in blast at the plant. The furnace has been banked since last April. Blast Furnace G at the mill is being relined.

The Donner Steel Co., Buffalo, N. Y., has blown in a second stack at its plant. The Rogers, Brown Co. has also placed a second furnace in blast at its mill.

In the Buffalo, N. Y., district, one blast furnace is now in operation at each of the plants of the Buffalo-Union Furnace Co., Wickwire-Spencer Steel Co. and the Lackawanna Steel Co.

Steel.—The Canonsburg Steel & Iron Co., Canonsburg, Va., has arranged for immediate resumption of operations at its local plant, following a shut-down since last spring. The company specializes in the manufacture of sheet steel, with plant giving employment to about 400 men.

The Atlantic Foundry Co., Akron, Ohio, is operating at full capacity in its steel department. The gray iron castings department is running at about one-half normal.

Enamelware.—The National Sanitary Manufacturing Co., Salem, Ohio, has increased production to about 60 per cent of normal, and plans to run full at an early date.

Alcohol.—The United States Industrial Alcohol Co., 27 William St., New York, is planning for the immediate reopening of another distillery at its New Orleans, La., plant, following a period of idleness. The company resumed at one of its New Orleans distilleries about the middle of October. The Baltimore, Md., plant of the company is running full.

Czechoslovakia Restricts Exports

The exportation from Czechoslovakia of sulphur, phosphorus, mercury and various chemicals, drugs and fertilizers, has been forbidden until further notice.

Chemists Clubs Exchange Greetings

During the recent visit of the British Society of Chemical Industry to the United States greetings were exchanged between the Chemical Industry Club, London, and the Chemists' Club, New York. The following message was conveyed to the Chemists' Club by Captain C. J. Goodwin on behalf of the Chemical Industry Club:

Aug. 10, 1921.

To the Chemists' Club, New York:

The chairman and the committee of the Chemical Industry Club, London, desire on behalf of the members, on the occasion of the visit to the United States of representatives of the Society of Chemical Industry, to send their very cordial greetings to their colleagues of the Chemists' Club of New York.

Both institutions are united in a desire to cultivate and provide for the social side of chemical industry and chemical science, and by opening their doors to visiting members of either club have already done something and may yet do more to promote the acquaintance and consolidate the friendship of the chemists of both nations.

At the present moment the greetings we send through Captain Goodwin have more than a purely personal and domestic interest. They are an indication of the sincere desire on this side for increasing friendship and good understanding between Great Britain and the United States, as a guarantee not only of the progress of the two great English-speaking nations but of the peace and well-being of the world.

This visit takes place at a time when all the influences that make for international friendship need to be cultivated, and among the most stable bonds of unity is the common service of mankind through scientific research and the application of its results to industry. On this basis the scientists, and especially the chemists, of your nation and ours, may find common ground in their sympathies, aims and work. Both can gain nothing but good for a better acquaintance and closer association with each other, and in sending these words we desire you to accept them, not only as a courtesy, but as representing our sincere desire for ever increasing friendship and co-operation between Great Britain and the United States.

(Signed) H. Edwin Coley,
Hon. Sec.

The following cordial response was made to the Hon. Sec. of the Chemical Industry Club, by Thomas R. Duggan, trustee of the Chemists' Club:

Sept. 15, 1921.

Dear Mr. Coley: Your letter of the 10th of August was duly conveyed to the Chemists' Club through the kind offices of C. J. Goodwin. . . . It is needless for me to say that letters of this sort passing between the various countries where English is spoken can only do good, more especially when those countries are knitted together in one common cause; that is, the uplifting and the spreading of science throughout the English speaking races. . . . It is my pleasure to pass to you the friendly feeling which the whole of the Chemists' Club feels toward the Chemical Industry Club.

On behalf of the trustees and officials of the Chemists' Club I have to thank you for your kind greetings and also to thank Mr. Goodwin, who so kindly conveyed by word of mouth the feelings that have existed between the two Clubs and which he hoped and we also hope will exist for many years to come.

(Signed) Thomas R. Duggan,
Trustee.

Bauxite Deposits in Australia

The Australian bauxite deposits are being thoroughly investigated with a view to the establishment of an aluminum industry in that commonwealth.

Program, Baltimore Meeting, American Institute of Chemical Engineers

The fourteenth annual meeting of the American Institute of Chemical Engineers will be held in Baltimore, Dec. 6 to 9, with headquarters at the Emerson Hotel. In addition to the technical program and plant visits noted below, excellent arrangements have been made for the entertainment of the ladies.

TUESDAY, DEC. 6.

Meeting at Emerson Hotel.

9 a.m.—Registration.

9:15 a.m.—Business session. Canvass of ballots for officers. Reports of officers and council. Reports of committees.

10:30 a.m.—Reading of papers.

Symposium on Chemical Engineering and National Defense.

Address, President David Wesson.

"Chemical Engineering and National Defense," M. C. Whitaker.

"Explosives and Fertilizers," Alfred H. White.

12:10 p.m.—Luncheon at Emerson Hotel.

1:15 p.m.—Excursion to Curtis Bay Industries: The American Refractories Co.; the Davison Chemical Co. and Silica Gel Corporation; the U. S. Industrial Alcohol Co.

8:15 p.m.—"Get Together" at Maryland Country Club.

WEDNESDAY, DEC. 7.

9:15 a.m.—Leave for Edgewood Arsenal. Note: This visit is open to U.S.A. citizens only.

12:30 p.m.—Luncheon at Edgewood. A complete inspection and tour of the arsenal will be made during the morning and afternoon. Brigadier General Amos A. Fries will give a short address in connection with the inspection of the arsenal on the subject of chemical warfare.

8:15 p.m.—Theater party. Invitation extended to the ladies and the institute by the local committee and the local chemical industry.

THURSDAY, DEC. 8.

9:15 a.m.—Meeting at Emerson Hotel. Reading of papers.

Symposium on Chemical Engineering and National Defense, continued.

"The Future Warfare," Raymond F. Bacon.

"Chemistry and the Next War," Maximilian Toch.

"Fundamental Research in Conservation and Defense," Harrison E. Howe.

"The Chlorine Industry as an Essential Factor in Our National Defense," Benjamin T. Brooks.

12 p.m.—Visit to Annapolis.

1:30 p.m.—Luncheon at Carvel Hall, Annapolis.

8 p.m.—Meeting at the Johns Hopkins University at Homewood.

"The Oxidation of Carbon Monoxide to Dioxide at Room Temperatures by a Catalyst," Prof. J. C. W. Frazer.

"Ultra Violet Light," Prof. R. W. Wood.

FRIDAY, DEC. 9.

Meeting at Emerson Hotel.

9:15 a.m.—Business session.

10:15 a.m.—Reading of papers.

"Some Aspects of the Lime Industry," Major Edward Holmes.

Paper by Prof. Cavalier of France.

"Glass as a Material for Chemical Use," A. E. Marshall.

12 p.m.—Luncheon at Emerson Hotel.

1:15 p.m.—Visit to Baltimore industries: Practically all of the Baltimore plants engaged in chemical and allied lines of manufacture have offered to throw their plants open to the institute. Lists will be available at the registration desk, and arrangements made to suit the individual preferences of members.

7 p.m.—Subscription dinner at Emerson Hotel. $3 per cover.

SATURDAY, DEC. 10.

Optional visits at Baltimore and Washington.

Industrial Cost Association Holds Second Conference in Pittsburgh

With headquarters at the William Penn Hotel in Pittsburgh, Pa., the Industrial Cost Association held its second National Industrial Cost Conference on Nov. 2, 3 and 4. The meeting was well attended and the members departed with the comfortable feeling of having accomplished a creditable amount of useful work.

After registration and the other formalities had been gone through on Wednesday morning, the president, Horace S. Beck, controller S. K. F. Industries, Inc., New York, called the first session to order and made a short address. He commented on the work done by the association during its first year of existence and commended the officers and members on what had been accomplished. He also stated that it was planned for the coming year to have presented at each local section meeting a paper prepared under the direction of the executive committee of the association, in order to assist in the work of the sections.

The afternoon session was opened by an address of welcome from Mayor Babcock, of Pittsburgh. The conference then listened to a paper read by S. B. Taylor, general manager, S. K. F. Industries, Inc., New York, on "What the Sales Manager Should Have From the Accounting Department." Mr. Taylor enumerated various details and figures that must be supplied by the accounting department. He laid particular stress on the need for cordial co-operation between the members of the accounting department and the members of the sales department. The plea for co-operation was strongly indorsed in the discussion which followed his paper.

E. C. Grimley, Victor Talking Machine Co., Camden, N. J., then discussed the matter of taking inventories, contrasting the time required and the benefits accomplished from the old-fashioned annual or semi-annual inventory which necessitated shutting down the plant, and the more modern perpetual inventory as practiced in most progressive plants.

In the evening papers were read by F. S. Willett, controller, Dodge Manufacturing Co., Mishawaka, Ind., on "Responsibility of the Controller or Accountant in Times of Business Depression," and by T. W. Dinlocker and A. W. Wainwright, both of S. K. F., on "Idleness and Its Relation to Industry in Retrospect."

The Thursday morning session was opened by an interesting paper by Addison Boren, Yale & Towne Manufacturing Co., Stamford, Conn., on "Terminology." After luncheon at the Heinz plant the delegates listened to addresses by J. B. Ayres, sanitation and safety engineer, and Major William Hogg, assistant to the vice-president, National Tube Co., Pittsburgh. These gentlemen described some of the safety and sanitation work of the United States Steel Corporation and outlined the actual savings in dollars and cents possible to attain.

At the meeting of Friday morning, J. M. Howell, General Electric Co., Schenectady, N. Y., read a paper on "How Can a Cost System, Although Efficient, Demoralize an Organization?" In his paper he criticised the ready-made cost system as applied by certain consulting accountants and told of the harm it could do when local conditions were not taken into consideration.

U. S. Potters' Convention

At a special meeting of the executive committee of the United States Potters' Association at East Liverpool, Ohio, Oct. 20, it was voted to hold the annual convention of the organization at Washington, D. C., during the first week in December, with a three-day session.

German Ammonia Output to Be Marketed by Fertilizer Syndicate

Ninety-six per cent of the German output of ammonia will be marketed by the Fertilizer Syndicate, reports a cable from Berlin, but it is not expected that the syndicate will be able to place it on the market before June, owing to the present scarcity of raw material caused by the disaster at Oppau.

Atmospheric Pollution Committee, A.I.C.E.

A committee has been appointed by the American Institute of Chemical Engineers to study conditions in chemical engineering processes which result in the production of gases which pollute the atmosphere. It is the purpose of the committee to study the non-injurious effluent SO_2 gas concentrations rather than the result of processes producing said gas. The work of the committee will be carried on through investigations, publications and discussions of the results obtained. The committee will welcome any information or facts bearing on the question of atmospheric pollution in any of these phases relative to the chemical manufacturing industry either through members of the institute or others.

The membership of the committee is as follows: James R. Withrow, chairman, professor of industrial chemistry, Ohio State University, Columbus, Ohio; Charles Baskerville, professor of chemistry, College of the City of New York, New York, N. Y.; Arthur B. Conner, chemical engineer, Detroit Chemical Works, Detroit, Mich.; Andrew M. Fairlie, consulting chemical engineer, Atlanta, Ga.; Henry Howard, Grasselli Chemical Co., Cleveland, Ohio; Cyril B. Clark, chemical engineer, General Chemical Co., 25 Broad St., New York, N. Y.; Albert E. Marshall, works manager, Davison Chemical Co., Curtis Bay, Md.; Arthur M. Comey, E. I. du Pont de Nemours & Co., Wilmington, Del.

American Association of Textile Chemists and Colorists

Formal organization of the American Association of Textile Chemists and Colorists was completed at a meeting held in the Engineers' Club, Boston, Nov. 3.

Prof. Louis A. Olney, of the Lowell Textile School, was elected president. Other officers are: William D. Livermore, chief chemist of the American Woolen Co., Lawrence, Mass., and William H. Cady, chief chemist of the United States Finishing Co. of Providence, R. I., vice-presidents; Walter E. Hadley, chief chemist of the Clark Thread Co., Newark, N. J., secretary; Winthrop C. Durfee, consulting and manufacturing chemist, of Boston, treasurer, and the following executive council, who will govern the new association: George A. Moran, chief chemist of the Pacific Mills, Lawrence, Mass.; Walter M. Scott, chief chemist of Cheney Bros., South Manchester, Conn.; A. E. Hirst, chief chemist and assistant superintendent, American Printing Co., Fall River; Elmer C. Bertolet, professor of textile chemistry, Philadelphia Textile School; James L. Amsden, chemist of the Rockland Finishing Co., Haverstraw, N. Y., and W. K. Robbins, of the Amoskeag Manufacturing Co., Manchester, N. H.

The objects of the organization are:

To promote the technical interest of its members in the properties and application of dyes and the processes of scouring, bleaching and finishing.

To develop a closer relationship between theory and practice in the application of dyes and other chemicals used in the textile industry.

To serve the textile and color industries by developing standard methods of testing dyes and analyzing textile materials in general and of standardizing systems for these tests and recording their results.

To encourage research work along textile chemical lines.

To encourage and supervise the establishment of a complete textile chemical library.

Two classes of membership have been provided for—active and junior. Active members must be at least twenty-six years of age and actively engaged as textile chemists or in some branch of the application of dyes. Students and apprentices may become junior members.

Weeks and Ford to Confer

The Secretary of War and Henry Ford will "get down to figures," as the Secretary of War puts it, on Muscle Shoals at a conference slated for Nov. 18 in Washington. Since the Army engineers and Mr. Ford's engineers have reached an understanding as to the engineering phases of Mr. Ford's offer, all that remains to do is the bargaining.

Emergency Tariff Act Extended

The Senate on Nov. 8 voted to extend the emergency tariff act, which provides among other things for the control of certain dye and chemical imports, until the permanent tariff bill will have become a law. The consideration of the extension, to which there was no real objection, nevertheless gave an opportunity for further discussion on the floor of the Senate of the dye embargo. Senator Smoot of Utah, in urging that the act be extended, declared that no one is more opposed to a permanent dye embargo than himself, but he contended that as long as there is not enough protection under the Underwood act, which he declared all would admit is not sufficient, he urged that the present method of handling dye imports be continued until the permanent tariff becomes a law.

"For months past," said Senator Smoot, "I have been studying the question of German manufacture of dyes. I have collected current prices in Germany, Switzerland, England and in other countries. I also have collected the prices of American products. I am quite certain that we can protect the industry without imposing an embargo."

The bill as it passed the House was extended until Feb. 1. This was amended by the Senate so as to continue the emergency tariff in force "until otherwise provided by law." The discussion of the amendment revealed that the passage of the tariff bill may be delayed much longer than had been expected. One Senator predicted that it would not be enacted until summer.

Senator Pomerene of Ohio declared that "the dye-makers have got control of chemists, at least persuasively so, and chemists have come to the conclusion that they are not able to do anything in this country without an embargo." He expressed curiosity as to the source of the chemists' inspiration. He said the word "embargo" was hated in America more than any other one word in the language. Since Senator Pomerene's position is typical of that of a considerable number of Senators, his remarks are of interest as they outline the reasoning of those who are opposed to the granting of that measure of protection. Among other things he said:

"It is little short of a crime to place the woolen, the cotton, the silk and the paint industries of this country in a position where they must buy all of their supplies at home. Many domestic dyes are the equivalent of those produced elsewhere, but many are not good. The dye-makers in their unadulterated selfishness would place all of those great industries entirely at the mercy of themselves. I do not think it makes much difference to those industries whether they are dominated by a German dye trust or an American dye trust.

"I do not think the dye-makers are in danger of destruction by competition from abroad. During the past year only $5,000,000 worth of dyes was brought into this country, while nearly $30,000,000 worth was shipped out. American dyes were shipped abroad and were sold in other countries in competition with German dyes."

Senator Pomerene read from correspondence with H. W. Harris of Alliance, Ohio, who served more than 25 years in the consular service. In that correspondence he pointed out that American textiles are being crowded out of foreign markets because of the inferiority of the dyes used.

Chemistry Building Dedicated at Dartmouth

The Steele Chemistry Building at Dartmouth College, Hanover, N. H., the latest addition to the institutional buildings, was dedicated on Oct. 29 in the presence of Governor A. O. Brown of New Hampshire, former Governor Samuel E. Pingree of Vermont, Dean Henry P. Talbot of the Massachusetts Institute of Technology and Dr. William H. Nichols. The structure was erected through a bequest of $250,000 from the late Sanford H. Steele, an alumnus of Dartmouth.

Early Vote on Patent Office Salary Bill

Early consideration of the bill providing for increases in salaries and certain reorganization in the Patent Office is assured. A majority of the Committee on Rules is understood to have agreed to vote for a special rule which will bring that bill before the House for a final vote soon.

Personal

CHARLES E. HEILMAN, chief metallurgist of the General Motors Laboratory, spoke on Nov. 10 on "Correlation Between the Testing of Automotive Parts, With Their Heat-Treatment and Service," at the Detroit Chapter of the American Society for Steel Treating.

HARRISON E. HOWE has been elected editor of the *Journal of Industrial and Engineering Chemistry* and director of the American Chemical Society News Service, to succeed Dr. Charles H. Herty. Dr. Howe has had a wide and varied experience in chemical industry. After completion of post-graduate work at the University of Michigan, Dr. Howe began his commercial career by accepting a position in the beet-sugar industry. Later he became chief chemist of the refinery. In 1904 Dr. Howe joined the staff of the Bausch & Lomb Optical Co. At first he was attached to that concern's Chicago office and traveled widely in that region in an effort to interest schools and others to use more scientific apparatus. Later he became branch manager of the Chicago office. After a time he was transferred to Rochester, N. Y., to edit the publications and books of instruction of the company. From that post he was promoted to the position of chief chemist. In 1916 Dr. Howe was employed by Arthur D. Little, Inc., as a chemical engineer and as manager of its commercial department. Later he was transferred to Montreal as assistant to the president. While in Canada he was engaged in the important survey of the dominion's natural resources made for the Canadian Pacific Railway. During the war Dr. Howe went to Washington as a consulting chemist in the Nitrate Division of the Ordnance Department of the Army. After the Armistice he returned to the Little company for a short period and on June 1, 1919, joined the staff of the National Research Council as the chief of its Division of Research Extension. He has been a member of the Council of the American Chemical Society since 1912 and is now a councilor-at-large. He is a member of the committee on national policy and was formerly chairman of the Division of Industrial and Engineering Chemistry of the society. He was instrumental in forming the society's Rochester section. He is the representative of the American Institute of Chemical Engineers on the board of American Engineering Council.

Dr. ERNEST FOX NICHOLS, inaugurated last spring as president of the Massachusetts Institute of Technology, was prevented by illness from assuming his duties at the opening of the academic year. He is expected to return about Jan. 1. His ill health was brought about by overwork previous to his election to the presidency. Meanwhile the institute will be governed by an administrative committee.

Dr. WILLIAM H. NICHOLS addressed the Rochester Chamber of Commerce at its midweek luncheon, Nov. 2.

Prof. LOUIS A. OLNEY, of the Lowell Textile School, has been elected president of the newly organized American Association of Textile Chemists and Colorists.

LATHROP E. ROBERTS, of Northampton, Mass., has been added to the Bureau of Mines staff at Berkeley, Cal., to take care of the additional work in physical chemistry. Mr. Roberts will be in immediate charge of the physical chemistry work at Berkeley, Cal. He is a graduate of the University of Chicago and has done extensive work on the theory of orientation of molecules. He was instructor in chemistry for two years at the University of Pittsburgh and for the past eighteen months has been in charge of the research laboratory of the American Writing Paper Co., Holyoke, Mass.

ERNEST T. TRIGG, Philadelphia, Pa., an official of John Lucas & Co., manufacturers of paints and varnish, has been appointed chairman of the recently established industrial relations committee of the Chamber of Commerce of the United States, Washington, D. C.

Dr. LANSING S. WELLS, until recently research chemist with The Barrett Co., Frankford, Philadelphia, Pa., has accepted an appointment as assistant professor of organic and physical chemistry, Montana State College, Bozeman.

SANFORD L. WILLIS, of the Corning Glass Works, sailed for Glasgow, Scotland, on Nov. 12. During the next four months Mr. Willis intends to visit the principal industrial centers of Europe, where his work will be concerned chiefly with an investigation of the foreign patents and manufacturing rights for Pyrex glassware.

JOHN F. WOOD, East Liverpool, Ohio, heretofore secretary-treasurer of the National Brotherhood of Operative Potters, has been elected president to succeed Edward Menge, who resigned recently on account of ill health.

Obituary

GEORGE L. GOULD, a prominent paint manufacturer of Boston and a former president of the National Paint, Oil and Varnish Association, died at his home in Malden, Mass., on Oct. 30. He was born in Woburn, Mass., on Feb. 6, 1852. Mr. Gould started in the paint business in 1867 and for more than thirty years was president of the Gould & Cutler Corporation of Boston. He was also a director of Benjamin Moore & Co., Brooklyn, and president of C. J. Prince Co. of Boston. Mr. Gould was the author, in 1914, of a historical sketch of the paint, oil and related industries of Boston, and in many other ways had contributed to the development of these industries.

GEORGE H. STEVENSON, of Maplewood, N. J., who for the past eighteen years had been connected with the General Chemical Co. of New York, died on Oct. 31 at the age of fifty-four years.

DIMITRI KONSTANTINOVITCH TSCHERNOFF was born in Petrograd, Russia, on Nov. 1, 1839, and died on Jan. 2, 1921.

He obtained his early education in the Russian Gymnasium (corresponding to the American high school), after which he entered the Technologic Institute. On graduation from this institute in 1858 he was engaged as a professor of geometry and algebra and later as a librarian and superintendent of the museum in the same institute. At the same time he attended lectures in the mathematical physics section at the University of Petrograd. In 1866 Tschernoff left the institute and entered the employ of the Obouchoff steel plant (founded three years previously), where steel guns were manufactured. It was in this period of his life that the most important and pioneer work was done by him on the heat-treatment of steel, its crystallization and metallography.

In 1880 he left the Obouchoff plant and went to the south of European Russia, where he discovered and developed some rock salt mines. This enterprise brought him a rather large fortune. Tschernoff returned to Petrograd in 1884 and held several prominent positions in government departments. Five years later he became professor of metallurgy in the Michael Artillery Academy, in which capacity he remained up to the time of the Russian revolution. During that autumn he was spending his vacation as usual in city of Yalta (Crimea). The events of the Russian revolution progressed very rapidly, so that Prof. Tschernoff, with his wife and daughter, was compelled to stay in Yalta without being provided for the winter season. Suffering from hunger and the lack of sufficient clothing, and deprived of his books and laboratory, Tschernoff nevertheless continued his work as well as he could, and gave a number of lectures on steel before classes in the local Polytechnic Institute. At the same time he worked on some mathematical problems, but his physique broke down through long-continued undernourishment and on Jan. 2, 1921, he passed away.

His works in metallurgy are very well known to the students of that science and a good abstract of his most important papers was published in *Revue de Métallurgie* in 1915 (pp. 829-882) in commemoration of his seventy-fifth birthday. It may be pointed out here that he was a man of remarkable versatility. Perhaps next to metallurgy his interest lay in such widely diversified branches of knowl-

DIMITRI KONSTANTINOVITCH TSCHERNOFF

edge as astronomy, aviation and botany. Photography also claimed a large part of his interest and attention, and his favorite photographs were those he took of the frost on the windows of his conservatory. Some of the photographs in this wonderful collection were used during his lectures on the crystallization of steel. Among other things in which he evinced great interest was the construction of the violin and the violoncello, of which he was very fond. He advanced a theory that the fibers of the wooden boards comprising the violin box should be arranged in a certain manner in order to obtain the best tonal value. Violins which he constructed in accordance with this theory were found to be of excellent tone and enjoyed considerable popularity among Russian musicians.

In his house, surrounded by a beautiful park and located in the remote residential part of Petrograd, Tschernoff led a very simple and modest life, being entirely devoted to his family and his works. In spite of very poor eyesight, which he overstrained while making his observations on the bessemer process, he was a very hard reader. On the large table in his office one could notice a great number of the latest editions and magazines on various subjects and written in different languages. He was absorbed from very early in the morning and up to late in the evening in his endless study, taking a respite for a short time by working in his garden or in his small machine shop. He permitted himself a good rest during only two days in each month. Every other Sunday of the month his house was opened to a company of his own friends, and his family acquaintances. In the evenings of these Sundays Tschernoff usually placed chess, to which, like his old friend Mendeléeff, he was ardently devoted.

As in the case of a number of Russian scientists, the horrors of the revolution compelled him to live the last three years of his life under very miserable conditions, which broke his body but not his spirit, for according to a letter from his younger son he continued his study and work up to the last moments of his life. So far as is known at the present time, his widow, Mme. A. N. Tschernoff, and one of their daughters live in Petrograd (Sergievskaia St. No. 1, Apt. 1) under miserable conditions.

A. I. KRYNITZKY.

Current Market Reports

The Chemical and Allied Industrial Markets

NEW YORK, Nov. 14, 1921.

The chemical market during the past week was not very brisk, owing to the holiday spirit, and trading was confined to small quantities. Exporters report a steady demand for the more important commodities and the market seems to be in good shape on these products. Consumers have been purchasing caustic soda in carload lots at lower figures, but lesser quantities are still commanding top-notch prices. Cream of tartar has firmed up considerably and recent quotations have been well sustained. Yellow prussiate of soda has eased up after a period of extreme activity and goods are now available in several additional quarters. Caustic potash opened rather dull, but finished very strong, with buyers paying particular attention to the available supplies of spot material. Yellow prussiate of potash was firmer, with supplies limited and the call decidedly better. There was also an increased export demand from the Far East for formaldehyde. In general, the market had every appearance of stability. Prices all around show signs of remaining steady and resale surplus stocks are diminishing in noticeable volume.

CHEMICALS

Recent importations of powdered *chlorate of potash* have had a discouraging effect on trading and the market remained dormant, with prices a trifle easier. Sales were quoted down to 6c. per lb. at the close of the week. The general tone of the market was rather weak. The crystal variety, however, remained firm at 8c. per lb. Small-lot trading was about the only thing that featured the market on *bichromate of potash*, with prices hovering around 11@ 11½c. per lb. for spot material. Consumers have shown some interest in this item, but business still retains its conservative form of trading. Firmness in *yellow prussiate of potash* was characteristic of the market and prices closed somewhat higher at 21c. per lb. Limited stocks among leading holders have caused this strength in the local market. Trading in *bichromate of soda* was fairly active and prices remained unchanged at 8¼@8½c. per lb. The tendency of the *caustic soda* market was toward lower levels, and sales at the close were reported down to $4 per 100 lb. for carload quantities. Lesser lots sold at $4.10@ $4.20. Leading producers of prime *acetate of soda* are finding a steady outlet among consumers at 4@4½c. per lb. Dealers in the resale market are offering odd lots at 4c. per lb., with a probability of shading on round-lot actual business. There was a relaxation noted in the market on *yellow prussiate of soda* and prices eased off slightly to 14½c. per lb. The demand was rather quiet and imported shipments were noted in several new directions. Business in *oxalic acid* was reported more active since the recent sharp slump and orders were placed in better volume at 12½c. per lb. The market ranged up to 14c. per lb. according to quantity and seller. Prime *Glaubers salt* is offered by producers at $1.50 per 100 lb. packed in single bags for carload quantities and up to 2c. per 100 lb. for smaller lots. The inquiry on this product seems to be fairly active, with consumers in several instances looking for contract figures. Manufacturers of *zinc carbonate* report sales to the consuming trade at 16c. per lb. Second-hand merchants quote the market about 2c. per lb. lower on firm business. The demand for the chemical has not been so very bright and most of the passing transactions have been for small quantities. The market on *soda ash* is reported steady, although business during the past week has not come up to expectations. Domestic ash remains practically unchanged at $2.10 per 100 lb. for large quantities and up to $2.50 for proportionately smaller lots. Foreign material is available at $1.95@$2 per 100 lb. A noteworthy improvement is reported in *formaldehyde* on the spot market and prices remained quite firm. The domestic demand has become more active and export business has shown a decided

improvement, especially to Japan. Prices remained at 11@11½c. per lb. for quantity orders. Producers of *silicate of soda* quote carlots of the 60 deg. at $2.30 per 100 lb., with less than carload quantities at 3c. per lb. The 40 deg. test is offered at 95c. per 100 lb. for large-quantity orders. Business seems to be running along in fair fashion with the inquiry coming from various consuming channels. Trading in *nitrite of soda* was rather limited and the market closed at 7@7½c. per lb. Buyers did not seem very anxious to buy at the quoted figures and purchased only small quantities for immediate necessities.

Coal-Tar Products

The coal-tar products market displayed practically the same tendency as the heavy chemical market. Holiday periods had somewhat of a bad effect on trading and stability of prices, but in general the entire list showed signs of firmness. Inquiries were more numerous and leading producers were optimistic about the outlook for the near future. The leading feature of the market was the increased demand for phenol, and factors are predicting higher prices for this product in the very near future. Naphthalene flakes have also attracted considerable attention in the market and holders are keeping their spot stocks well in hand for the expected rise in price. Imported arrivals have not been as plentiful as a few months ago, owing to the recent additional tax of 15 per cent ad valorem. Dimethylaniline attributed considerable activity and showed increased strength both in inquiries and prices. The *benzene* market still remains in the same unsettled condition, with spot supplies practically exhausted even among second-hand dealers. Coke-oven operations have improved somewhat, but no effect will in any way be noticeable on the spot market for at least another month. *Naphthalene flakes* are firm, with the demand better from various quarters and quotations running around 7c. per lb. in second-hand channels and up to 8½c. per lb. from producers. Leading factors expect a rise soon. *Phenol* has shown some considerable improvement and large holders of prime material are quoting revised prices. Sellers holding large export orders were somewhat surprised to learn that all the better grade product is being withheld from the spot market at the present levels. Sales of prime white goods were made at 9½c. per lb. Sales of *dimethylaniline* were made at 60c. per lb., with other factors quoting up to 65c. per lb. The demand has shown that consumers have used the major portion of their old stocks and are eager to feel out the present market. Inquiries for *benzaldehyde* are being received in fairly good volume and sales for U.S.P. material were recorded at $1.35 per lb. Resellers of *aniline oil* are maintaining prices around 18c. per lb., which is about the figure asked by producers. Buyers have not shown any real snap to trading and spot stocks have not been diminishing rapidly enough to keep prices steady.

Waxes

Importers of *beeswax* report a steady demand for the low grades and prices ruled quite steady. The crude African closed at 14@15c. per lb., with the Brazilian at 21@23c. per lb. Pure white refined was held at 34@38c per lb. according to quantity and seller. Traders in *candelilla wax* reported a better demand, and prices were quoted higher at 25@25½c. per lb. Available stocks were somewhat limited. Spot offerings of *Japan wax* were reported at 22@24c. per lb. The general tone of this market was hardly steady, probably because of weak shipment prices. *Japan wax* for shipment closed at 16@16½c. per lb. c.i.f. New York. There were numerous offerings of *carnauba wax* in the market, but shipment prices showed very little change, leaving the general tone of the market practically unchanged. The demand was for small lots. No. 1 closed at 45c. per lb., with No. 2 North Country at 23c. per lb. The No. 3 North Country was held at 14½@15c. per lb. for prompt delivery. Prices on crude oil advanced sharply during the week, but this did not seem to have any noticeable effect on buyers of *paraffine wax*. Sellers have tried to advance prices in proportion to the advance in crude oil, but the movement did not show any signs of aggressiveness. Some large holders, on the other hand, have withdrawn from the market.

The St. Louis Market

St. Louis, Mo., Nov. 11, 1921.

Activities in the chemical and drug markets continue to show increased signs of improvement and conditions as a whole have a very bright appearance. Dealings in the month of October increased considerably over those of preceding months and the first ten days of the present month show an appreciable increase over the same period of last month. It was expected that the calling off of the railroad strike would have a bad effect on the market for the more important commodities; however, this was not the case, as the demand continued, in fact, with a marginal increase.

Heavy importations of foreign chemicals have been noted for some time but with no ill effect on the domestic market, which leads us to suppose that the bulk of the importations is going direct to the consuming trade and not being distributed among second hands.

The general market shows no weakness and the tendency of manufacturers is to advance rather than follow the other direction, for many of the prices that are ruling are not consistent with manufacturing costs and have been forced only by the keen competition. Many of the more important items have taken an upward trend already, as for instance, salicylates, which took a sudden rise this week.

Buyers are more optimistic, as is evidenced by the increase in the volume of orders, further indicating that business is on the road to improvement.

Alkalis

The market on *caustic soda* is very firm and continues at $4 per 100 lb. for 73 to 75 per cent solid, f.o.b. point of production. No change in *soda ash*, *bicarbonate soda* or *sal soda*.

Chemicals, Drugs and Pharmaceuticals

Ammonia water, 26 deg., moves in routine way. An extraordinarily heavy demand for *sulphate ammonia*, pure granular, has been experienced the past several weeks and continues today. *Bismuth salts*, especially the *subnitrate*, is moving very strong in spite of the fact that this is the off season. *Bromides* are commanding a fair position. The heavy demand recently reported on *carbon bisulphide* has slowed up to some extent. *Cream of tartar* is experiencing a fair demand. *Creosotes* and *guaiacols* are now commanding a very good demand and this should continue for the reason that this is the season for these two commodities and large stocks should be carried. *Ethers* are moving freely. The photographic trade is making quite a demand for hydroquinone and recently manufacturers have reduced their schedule. *Hypo* is moving through regular channels at regular rates. Among the iodides, *iodine resublimed* and *potash* are the heavy sellers, at the present time, but the remainder of the *iodide salts* are also holding their own. Consumers are making a heavy demand on manufacturers for *salicylates*, especially the *acetyl salicylic acid*, of which there is an apparent shortage. The *salicylates* have also advanced the early part of this week. *Soda benzoate* continues to be in demand. Inquiries and demand for *thymol iodide* are very good. The demand for *zinc stearate* continues, although not much is expected of this commodity at this time, as the season is over. *Zinc sulphate*, pure granular, is moving in a lively way.

Acids

Manufacturers of heavy mineral acids report a continued increase in activities and look for further improvement in the near future. *Acid benzoic* is moving in a fair way. Fair quantities of *citric acid* are being sold, undoubtedly due to wholesalers' stocks being exhausted. *Gallic acid* and *pyrogallic acid* are in good demand; the manufacturers are in good position to fill large orders. *Acid tartaric* is moving in a routine way.

Vegetable Oils and Naval Stores

Turpentine has stiffened very strongly during the last week, reaching price of 85c. in single barrels and 81c. in 5-bbl. lots ex-warehouse. *Castor oil* remains firm with prevailing price of 12½c. per lb. *Linseed oil* has advanced slightly over last week and is now moving at 70c. basis raw oil ex-warehouse.

The Iron and Steel Market

PITTSBURGH, Nov. 11, 1921.

Production of steel ingots in October was at the rate of about 44 per cent of capacity, the highest rate shown since February and more than double the rate of last July. There was a sharp increase July to August, a small increase August to September and a large increase September to October.

The Steel Corporation's unfilled obligations decreased by 273,841 tons during September, against an increase of 28,744 tons in September and decreases averaging about 500,000 tons a month in the 13 months preceding. The Steel Corporation's unfilled tonnage, long regarded as a useful index to business conditions, would be quite misleading if interpreted in the usual way, when increases have been regarded as favorable and decreases as unfavorable. The corporation entered this year with a large volume of contract business with customers. There was little occasion to enter additional tonnage, as customers were covered. Requirements of customers were indicated by their specifying against contracts. Shipments represented activity and decreased the unfilled tonnage. In March the corporation shipped its products at about 51 per cent of capacity and the unfilled tonnage decreased 649,102 tons. In July the corporation shipped at about 25 per cent and the unfilled tonnage decreased by only 287,544 tons. Which was the better month?

In each month, March to August inclusive, the new bookings of contract or other tonnage were very small, the decrease in unfilled obligations being but a trifle less than the shipments. In September two price advances occurred, in wire products and sheets respectively, bringing in considerable quantities of business at the old prices. The shipments were at about 34 per cent of capacity and the increase in unfilled obligations about 2 per cent, indicating that bookings were at about 36 per cent of capacity, easily the largest bookings for months. In October the shipments were at about 44 per cent of capacity, while the decrease in unfilled tonnage was about 20 per cent of capacity, indicating bookings at about 24 per cent.

STEEL PRICES

Finished steel prices in general exhibit a slight sagging tendency from week to week. In most if not all products there can be no clear cut declines for the simple reason that there are no clear cut prices. Sales occur at various prices according to the tonnage of order and the character of specifications, as well as the particular needs of a mill for rolling schedules at one time and another. There is, of course, quite free competition. Sales of bars, shapes and plates generally fall within the range of 1.50@1.60c. In sheets there are "regular" prices of 3c. on black and 4c. on galvanized, and these prices are shaded somewhat more than a week ago. In tubular goods there are published lists, the shading of which is more widespread than a week ago, though perhaps no deeper. Tin plate presents a stable market. For a long time several independents were shading the Steel Corporation price of $5.25, the corporation departing from its common policy of 6 months or so past in the matter of recognizing price competition, but on Nov. 3 the corporation decided to reduce its price to $4.75. At this price the market seems stabilized.

PROSPECTS

Recovery from the extremely low production rate of last July was unavoidable, because at that time consumption was being taken care of partly by stocks, and in time the stocks would be liquidated. The 44 per cent operating rate of last month involves a different condition, the production probably balancing the country's needs with general business of its present volume and character. So little steel is being taken by the railroads and so little is passing into large construction jobs that the remainder represents really a fairly large tonnage for the common everyday activities. The production of steel, measured in ingots, is just equal to production in 1906 and 1907, years of great activity and years in which much steel passed to railroads and into large construction undertakings. The general public, so to speak, is taking much more steel than in 1906 and 1907, although population has increased by only about 22 per cent.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

		Carlots	Less Carlots
Acetic anhydride	lb.	–	$0.40 – $0.45
Acetone	lb.	$0.12½ – $0.12½	.13 – .13½
Acid, acetic, 28 per cent	100 lbs.	2.75 – 3.00	3.25 – 3.50
Acetic, 56 per cent	100 lbs.	6.00 – 6.25	6.50 – 7.00
Acetic, glacial, 99½ per cent, carboys,	100 lbs.	10.75 – 11.00	11.25 – 11.50
Boric, crystals	lb.	.12½ – .13	.13½ – .14
Boric, powder	lb.	.13 – .13½	.14 – .14½
Citric	lb.	–	.45 – .47
Hydrochloric	100 lb.	1.25 – 1.50	1.60 – 1.75
Hydrofluoric, 52 per cent	lb.	.12 – .12½	.12½ – .13
Lactic, 44 per cent tech	lb.	.09½ – .10	.10½ – .12
Lactic, 22 per cent tech	lb.	.04½ – .05½	.06 – .07
Molybdic, C.P.	lb.	3.25 – 3.50	3.60 – 4.00
Muriatic, 20 deg. (see hydrochloric)		–	–
Nitric, 40 deg.	lb.	.06½ – .06½	.06½ – .07
Nitric, 42 deg.	lb.	.06½ – .07	.07½ – .07½
Oxalic, crystals	lb.	.12½ – .13	.13½ – .14½
Phosphoric, 50 per cent solution	lb.	.13 – .13½	.14 – .18
Picric	lb.	.20 – .25	.27 – .35
Pyrogallic, resublimed	lb.	–	1.90 – 2.00
Sulphuric, 60 deg., tank cars	ton	–	11.00 – 12.00
Sulphuric, 60 deg., drums	ton	–	13.00 – 15.00
Sulphuric, 66 deg., tank cars	ton	17.00 – 18.00	–
Sulphuric, 66 deg., drums	ton	21.00 – 22.00	22.50 – 23.00
Sulphuric, 66 deg., carboys	ton	–	–
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	21.00 – 22.00	–
Sulphuric, fuming, 20 per cent (oleum) drums	ton	23.00 – 23.50	24.00 – 24.50
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	–	.75 – .85
Tannic (tech.)	lb.	.45 – .48	.50 – .55
Tartaric, imported crystals	lb.	–	.26 – .27
Tartaric acid, imported, powdered	lb.	–	.27½ – .28½
Tartaric acid, domestic	lb.	–	– .35
Tungstic, per lb. of WO	lb.	–	1.10 – 1.20
Alcohol, Ethyl	gal.	–	4.70 – 5.00
Alcohol, Methyl (see methanol)		–	–
Alcohol, denatured, 188 proof	gal.	–	.37 – .38
Alcohol, denatured, 190 proof	gal.	–	.35 – .36
Alum, ammonia, lump	lb.	.03½ – .03½	.04 – .04½
Alum, potash, lump	lb.	.03½ – .04	.04½ – .04½
Alum, chrome lump	lb.	.08½ – .09	.09½ – .10
Aluminum sulphate, commercial	lb.	.01 – .02	.02½ – .02½
Aluminum sulphate, iron free	lb.	.02½ – .02½	.03 – .03½
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.07½ – .07½	.08 – .08½
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.31 – .32	.33 – .35
Ammonium carbonate, powder	lb.	.07 – .07½	.08 – .09
Ammonium chloride, granular (white salammoniac)	lb.	.07 – .07½	.07½ – .07½
Ammonium chloride, granular (gray salammoniac)	lb.	.07 – .07½	.07½ – .07½
Ammonium nitrate	lb.	.07½ – .07½	.07½ – .08½
Amylacetate tech.	gal.	–	2.40 – 2.70
Arsenic oxide, (white arsenic) powdered	lb.	.06 – .06½	.06½ – .07
Arsenic, sulphide, powdered (red arsenic)	lb.	.11 – .11½	.12 – .13
Barium chloride	ton	58.00 – 60.00	62.00 – 70.00
Barium dioxide (peroxide)	lb.	.20 – .21	.22 – .23
Barium nitrate	lb.	.07½ – .08	.08½ – .09
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04½	.04½ – .05
Bleaching powder (see calc. bypochlorite)		–	–
Blue vitriol (see copper sulphate)		–	–
Borax (see sodium borate)		–	–
Brimstone (see sulphur, roll)		–	–
Bromine	lb.	.27 – .28	.28½ – .30
Calcium acetate	100 lbs.	1.85 – 2.00	–
Calcium carbide	lb.	.04½ – .04½	.05 – .05½
Calcium chloride, fused, lump	ton	23.50 – 24.00	24.50 – 25.50
Calcium chloride, granulated	lb.	.01½ – .02	.02½ – .02½
Calcium hypochloride (bleach'g powder)	100 lb.	2.25 – 2.30	2.35 – 3.00
Calcium peroxide	lb.	–	1.40 – 1.50
Calcium phosphate, tribasic	lb.	–	.15 – .16
Camphor	lb.	–	.85 – .90
Carbon bisulphide	lb.	.06½ – .06½	.07 – .07½
Carbon tetrachloride, drums	lb.	.10½ – .10½	.11 – .12
Carbonyl chloride, (phosgene)	lb.	–	.60 – .75
Caustic potash (see potassium hydroxide)		–	–
Caustic soda (see sodium hydroxide)		–	–
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.08 – .09	.09½ – .10
Chloroform	lb.	–	.40 – .43
Cobalt oxide	lb.	–	2.00 – 2.10
Copperas (see iron sulphate)		–	–
Copper carbonate, green precipitate	lb.	.20 – .20½	.21 – .22
Copper cyanide	lb.	–	.50 – .62
Copper sulphate, crystals	lb.	.05 – .05½	.05½ – .06
Cream of tartar (see potassium bitartrate)		–	–
Epsom salt (see magnesium sulphate)		–	–
Ethyl Acetate Com. 85%	gal.	–	.80 – .90
Ethyl Acetate pure (acetic ether, 98% to 100%)	gal.	–	.95 –
Formaldehyde, 40 per cent	lb.	.11 – .11½	.11½ – .12½
Fusel oil, ref	gal.	–	2.50 – 3.00
Fusel oil, crude	gal.	–	1.50 – 1.75
Glauber's salt (see sodium sulphate)		–	–
Glycerine, C. P. drums extra	lb.	–	.14½ – .15
Iodine, resublimed	lb.	–	3.50 – 3.60
Iron oxide, red	lb.	–	.12 – .18
Iron sulphate (copperas)	ton	18.00 – 19.00	20.00 – 23.00
Lead acetate	lb.	–	.10½ – .12½
Lead arsenate, powd.	lb.	.15 – .15½	.15½ – .16½
Lead nitrate	lb.	–	.15 – .20
Litharge	lb.	.07½ – .08	.08½ – .09
Lithium carbonate	lb.	–	1.40 – 1.50
Magnesium carbonate, technical	lb.	.08 – .08½	.09 – .10
Magnesium sulphate, U. S. P.	100 lb.	2.50 – 2.75	–
Magnesium sulphate, technical	100 lb.	–	1.10 – 1.75
Methanol, 95%	gal.	–	.66 – .68
Methanol, 97%	gal.	–	.70 – .72
Nickel Salt, double	lb.	–	.12 – .12½
Nickel salt, single	lb.	–	.14 – .14½
Phosgene (see carbonyl chloride)		–	–
Phosphorus, red	lb.	.40 – .41	.42 – .45
Phosphorus, yellow	lb.	–	.30 – .35
Potassium bichromate	lb.	.11 – .11½	.11½ – .12

		Carlots	Less Carlots
Potassium bitartrate (cream of tartar)	lb.	$.... – $....	$0.27 – $0.29
Potassium bromide, granular	lb.	..... –	.16 – .20
Potassium carbonate, U. S. P.	lb.	.15 – .16	.17 – .20
Potassium carbonate, 80–85%	lb.	.04½ – .04¾	.05 – .06
Potassium chlorate, crystals	lb.	.08 – .08½	.08½ – .12
Potassium cyanide	lb.	..... –	.40 – .45
Potassium hydroxide (caustic potash)	lb.	.05¼ – .06	.06¼ – .08
Potassium iodide	lb.	..... –	2.60 – 2.75
Potassium nitrate	lb.	.07¼ – .07½	.08 – .09
Potassium permanganate	lb.	.18 – .19	.20 – .22
Potassium prussiate, red	lb.	.28 – .29	.29½ – .30
Potassium prussiate, yellow	lb.	.21 – .21½	.21½ – .22
Rochelle salts (see sodium potas tartrate)	....	....	..... – .....
Salammoniac (see ammonium chloride)	....	....	..... – .....
Sal soda (see sodium carbonate)	....	..... –	..... – .....
Salt cake (bulk)	ton	..... –	20.00 – 22.00
Silver cyanide	oz.	..... –	1.35 – 1.38
Silver nitrate	oz.	..... –	.46 – .47
Soda ash, light	100 lb.	2.10 – 2.15	2.20 – 2.60
Soda ash, dense	100 lb.	2.35 – 2.40	2.45 – 2.70
Sodium acetate	lb.	.04 – .04½	.04½ – .05
Sodium bicarbonate	100 lb.	2.00 – 2.25	2.50 – 2.75
Sodium bichromate	lb.	.08½ – .08¾	.08¾ – .08¾
Sodium bisulphate (nitre cake)	ton	5.00 – 5.25	5.50 – 6.50
Sodium bisulphite powdered, U.S.P.	lb.	.04½ – .05	.05½ – .06
Sodium borate (borax)	lb.	.05½ – .06	.06½ – .07
Sodium carbonate (sal soda)	100 lb.	1.90 – 2.00	2.10 – 2.30
Sodium chlorate	lb.	.07½ – .07¾	.08 – .08½
Sodium cyanide	lb.	.28 – .28½	.29 – .30
Sodium fluoride	lb.	.11 – .12	.12½ – .14
Sodium hydroxide (caustic soda)	100 lb.	4.00 – 4.10	4.15 – 4.50
Sodium hyposulphite	lb.	..... –	.03½ – .03¾
Sodium nitrite	lb.	.07 – .07½	.07½ – .08
Sodium peroxide, powdered	lb.	.25 – .26	.27 – .30
Sodium phosphate, dibasic	lb.	.04½ – .04½	.04¾ – .05½
Sodium potassium tartrate (Rochelle salts)	lb.	..... –	.21 – .24
Sodium prussiate, yellow	lb.	.14½ – .14¾	.15 – .15½
Sodium silicate, solution (40 deg.)	100 lb.	.95 – 1.00	1.10 – 1.25
Sodium silicate, solution (60 deg.)	100 lb.	2.30 – 2.40	2.45 – 3.00
Sodium sulphate, crystals (Glauber's salt)	100 lbs.	1.50 – 1.75	2.00 – 2.25
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04½ – .05	.05½ – .05¾
Sodium sulphite, crystals	lb.	.03½ – .03¾	.04 – .04½
Strontium nitrate, powdered	lb.	.12 – .13	.13½ – .20
Sulphur chloride, red	lb.	.05 – .05½	.05½ – .06½
Sulphur, crude	ton	18.00 – 20.00	..... – .....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	..... –	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	..... –	2.00 – 2.75
Tin bichloride	lb.	.08½ – .09	.09½ – .10
Tin oxide	lb.	..... –	.37 – .38½
Zinc carbonate, precipitate	lb.	.16 – .16½	.17 – .17
Zinc chloride, gran.	lb.	.09 – .09½	.09¼ – .10
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc dust	lb.	.11½ – .11½	.11¾ – .12½
Zinc oxide, XX	lb.	.07½ – .07½	.08 – .09
Zinc sulphate	100 lb.	3.00 – 3.25	3.30 – 3.50

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha-naphthol, crude	lb.	$1.15 — $1.20
Alpha-naphthol, refined	lb.	1.25 — 1.30
Alpha-naphthylamine	lb.	.27 — .30
Aniline oil, drums extra	lb.	.18 — .20
Aniline salts	lb.	.24 — .26
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.35 — 1.45
Benzidine, base	lb.	.90 — 1.00
Benzidine sulphate	lb.	.75 — .85
Benzoic acid, U.S.P.	lb.	.60 — .65
Benzoate of soda, U.S.P.	lb.	.52 — .55
Benzene, pure, water-white, in drums (100 gal.)	gal.	.27 — .32
Benzene, 90%, in drums (100 gal.)	gal.	.25 — .28
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.70 — .75
Beta-naphthol, tech	lb.	.31 — .34
Beta-naphthylamine, sublimed	lb.	1.75 — 1.85
Cresol, U. S. P., in drums (100 lb.)	lb.	.16 — .17
Ortho-cresol, in drums (100 lb.)	lb.	.25 — .27
Cresylic acid, 97–99%, straw color, in drums	gal.	.70 — .80
Cresylic acid, 95-97%, dark, in drums	gal.	.65 — .70
Cresylic acid, 50%, first quality, drums	gal.	.45 — .50
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	1.10 — 1.20
Dimethylaniline	lb.	.45 — .60
Dinitrobenzene	lb.	.23 — .27
Dinitroclorbenzene	lb.	.20 — .25
Dinitronaphthalene	lb.	.30 — .35
Dinitrophenol	lb.	.35 — .40
Dinitrotoluene	lb.	.25 — .30
Dip oil, 25%, car lots, in drums	gal.	.30 — .35
Diphenylamine	lb.	.60 — .70
H-acid	lb.	1.05 — 1.15
Meta-phenylenediamine	lb.	1.15 — 1.20
Monochlorbenzene	lb.	.12 — .14
Monoethylaniline	lb.	1.65 — 1.70
Naphthalene crushed, in bbls.	lb.	.07 — .08½
Naphthalene, flake	lb.	.07 — .08½
Naphthalene, balls	lb.	.08 — .09½
Naphthionic acid, crude	lb.	.70 — .75
Nitrobenzene	lb.	.12 — .15
Nitro-naphthalene	lb.	.30 — .35
Nitro-toluene	lb.	.15 — .17
Ortho-amidophenol	lb.	3.00 — 3.10
Ortho-dichlor-benzene	lb.	.15 — .20
Ortho-nitro-phenol	lb.	.75 — .80
Ortho-nitro-toluene	lb.	.15 — .20
Ortho-toluidine	lb.	.20 — .25
Para-amidophenol, base	lb.	1.40 — 1.45
Para-amidophenol, HCl	lb.	1.70 — 1.80
Para-dichlorbenzene	lb.	.12 — .15
Paranitroaniline	lb.	.77 — .80
Para-nitrotoluene	lb.	.80 — .85
Para-phenylenediamine	lb.	1.70 — 1.75
Para-toluidine	lb.	1.25 — 1.40
Phthalic anhydride	lb.	.40 — .50
Phenol, U. S. P., drums	lb.	.09½ — .12
Pyridine	gal.	2.00 — 3.50
Resorcinol, technical	lb.	1.50 — 1.60
Resorcinol, pure	lb.	2.00 — 2.25
Salicylic acid, tech., in bbls.	lb.	.18 — .20
Salicylic acid, U. S. P.	lb.	.19 — .22
Salol	lb.	.70 — .72
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.25 — .28
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.14 — .16
Sulphanilic acid, crude	lb.	.27 — .30
Tolidine	lb.	1.30 — 1.35
Toluidine, mixed	lb.	.43 — .45
Toluene, in tank cars	gal.	.25 — .28
Toluene, in drums	gal.	.28 — .31
Xylidines, drums, 100 gal.	lb.	.40 — .45
Xylene, pure, in drums	gal.	.40 — .45
Xylene, pure, in tank cars	gal.	.45 — .....
Xylene, commercial, in drums, 100 gal.	gal.	.33 — .35
Xylene, commercial, in tank cars	gal.	.30 — ....

Waxes

Prices based on original packages in large quantities.

Bayberry Wax	lb.	$0.21 — $0.22
Beeswax, refined, dark	lb.	.24 — .25
Beeswax, refined, light	lb.	.28 — .30
Beeswax, white pure	lb.	.34 — .38
Candellila wax	lb.	.25 — .25½
Carnauba, No. 1	lb.	.45 — .46
Carnauba, No. 2, North Country	lb.	.23 — .23½
Carnauba, No. 3, North Country	lb.	.14½ — .15
Japan	lb.	.22 — .22½
Montan, crude	lb.	.04 — .04½
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04½ — .04¾
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.04 — .....
Paraffine waxes, refined, 118-120 m.p.	lb.	.04½ — .04½
Paraffine waxes, refined, 125 m.p.	lb.	.04 — .04½
Paraffine waxes, refined, 128-130 m.p.	lb.	.04½ — .05
Paraffine waxes, refined, 133-135 m.p.	lb.	.05 — .05½
Paraffine waxes, refined, 135-137 m.p.	lb.	.05½ — .06
Stearic acid, single pressed	lb.	.09¼ — ....
Stearic acid, double pressed	lb.	.10 — .....
Stearic acid, triple pressed	lb.	.11 — .11½

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.	280 lb.	$5.80 —	5.80
Rosin E-I	280 lb.	5.85 —	5.90
Rosin K-N	280 lb.	6.40 —	6.85
Rosin W. G.-W. W.	280 lb.	7.10 —	7.30
Wood rosin, bbl.	280 lb.	6.25 —	.....
Spirits of turpentine	gal.	.80½ —	.....
Wood turpentine, steam dist	gal.	.78½ —	.....
Wood turpentine, dest. dist.	gal.	.76½ —	.....
Pine tar pitch, bbl.	200 lb.	..... —	6.50
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	10.00
Retort tar, bbl.	500 lb.	—	10.00
Rosin oil, first run	gal.	.35 —	.....
Rosin oil, second run	gal.	.37 —	.....
Rosin oil, third run	gal.	.44 —	.....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		$1.90
Pine oil, pure, dest. dist.	gal.		1.50
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.35
Turpentine, crude, sp. gr., 0.900-0.970	gal.		1.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.35
Pinewood creosote, ref.	gal.		.52

Solvents

73-76 deg., steel bbls. (85 lb.)	gal.	$0.37
70-72 deg., steel bbls. (85 lb.)	gal.	.35
68-70 deg., steel bbls. (85 lb.)	gal.	.34
V. M. and P. naphtha, steel bbls. (85 lb.)	gal.	.23

Fertilizers

Ammonium sulphate, bulk and d. bags	100 lb.	$2.50 —	3.00
Blood, dried, f.o.b., N. Y	unit	4.00	
Bone, 3 and 50, ground, raw	ton	30.00 —	32.00
Cyanamide, f.o.b. works	unit	4.50	
Fish scrap, dom., dried, f.o.b. works	unit	2.90 —	3.00
Nitrate soda	100 lb.	2.35 —	2.45
Tankage, high grade, f.o.b. Chicago	unit	3.00 —	3.10
Phosphate rock, f.o.b. mines, Florida pebble, 68-72 p.c	ton	4.50 —	6.50
Tennessee, 78-80 p.c.	ton	8.50 —	9.00
Potassium muriate, 80 p.c.	ton	37.00 —	40.00
Potassium sulphate	unit	1.00 —	1.10

Crude Rubber

Para—Upriver fine	lb.	$0.21 —	.21½
Upriver coarse	lb.	.11½ —	.12
Upriver caucho ball	lb.	.11½ —	.12
Plantation—First latex crepe	lb.	.15½ —	.15½
Ribbed smoked sheets	lb.	.15½ —	.15½
Brown crepe, thin, clean	lb.	.15 —	.....
Amber crepe No. 1	lb.	.17 —	.....

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls.	lb.	$0.10½ —	$0.10¾
Castor oil, AA, in bbls.	lb.	.11½ —	.12
China wood oil, in bbls. (f.o.b. Pac. coast)	lb.	.13 —	.13½
Cocoanut oil, Ceylon grade, in bbls.	lb.	.09½ —	.09¾
Cocoanut oil, Cochin grade, in bbls.	lb.	.10¼ —	.10½
Corn oil, crude, in bbls.	lb.	.10 —	.10¼
Cottonseed oil, crude (f. o. b. mill)	lb.	.06¾ —	.07
Cottonseed oil, summer yellow	lb.	.08¾ —	.09
Cottonseed oil, winter yellow	lb.	.09½ —	.09¾

Linseed oil, raw, car lots (domestic)	gal.	.67 —	.68
Linseed oil, raw, tank cars (domestic)	gal.	.62 —	.63
Linseed oil, in 5-bbl lots (domestic)	gal.	.70 —	.71
Olive oil, Denatured	gal.	$1.15 —	$1.20
Palm, Lagos	lb.	.07½ —	.07¾
Palm, Niger	lb.	.06½ —	.06¾
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.08¼ —	.08½
Peanut oil, refined, in bbls	lb.	.11½ —	.11¾
Rapeseed oil, refined in bbls	gal.	.84 —	.86
Rapeseed oil, blown, in bbls	gal.	.92 —	.94
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.09 —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.07½ —	....
FISH			
Light pressed menhaden	gal.	$0.40 —	....
Yellow bleached menhaden	gal.	.42 —	....
White bleached menhaden	gal.	.45 —	....
Blown menhaden	gal.	.48 —	....

Miscellaneous Materials

All f.o.b. New York Unless Otherwise Stated

Barytes, ground, white, f.o.b. Kings Creek, S. C.	net ton	$24.00 —	30.00
Barytes, ground, off color, f.o.b. Kings Creek	net ton	20.00 —	24.00
Barytes, crude, 88%@94% ba., Kings Creek	net ton	10.00 —	12.00
Barytes, floated, f.o.b. St. Louis	net ton	23.00 —	24.00
Barytes, crude, first grade, Missouri	net ton	7.00 —	....
Blanc fixe, dry	lb.	.04 —	.04½
Blanc fixe, pulp	net ton	45.00 —	55.00
Casein	lb.	.07 —	.10
Chalk, Precipitated, domestic, extra light	lb.	.04½ —	.05
Chalk, Precipitated, domestic, light	lb.	.04 —	.04½
Chalk, Precipitated, domestic, heavy	lb.	.03½ —	.04
Chalk, Precipitated, English, extra light	lb.	.04½ —	.05
Chalk, Precipitated, English, light	lb.	.04½ —	.05
Chalk, Precipitated, English, dense	lb.	.04 —	.04½
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.50 —	8.50
China clay (kaolin) washed, f.o.b. Georgia	net ton	9.00 —	10.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	13.00 —	20.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00 —	12.00
China clay (kaolin) ground, f.o.b. Virginia points	net ton	13.00 —	20.00
China clay (kaolin), imported, lump	net ton	12.00 —	20.00
China clay (kaolin), imported, powdered	net ton	25.00 —	30.00
Feldspar, crude, f.o.b. Maryland and North Carolina points	net ton	5.00 —	7.50
Feldspar, crude, f.o.b. Maine	net ton	7.50 —	10.00
Feldspar, ground, f.o.b. Maine	net ton	21.00 —	23.00
Feldspar, ground, f.o.b. North Carolina	net ton	17.00 —	21.00
Feldspar, ground, f.o.b. N. Y. State	net ton	17.00 —	21.00
Feldspar, ground, f.o.b. Baltimore	net ton	27.00 —	30.00
Fullers earth, f.o.b. Mines	net ton	16.00 —	17.00
Fullers earth, granular, f.o.b. Pa	net ton	15.00 —	18.00
Fullers earth, powdered, f.o.b. Fla	net ton	18.00 —	....
Fullers earth, imported, powdered	net ton	24.00 —	27.00
Graphite, Ceylon lump, first quality	lb.	.06 —	.07
Graphite, Ceylon chip	lb.	.04½ —	.05
Graphite, high grade amorphous crude	lb.	.00½ —	.02½
Kieselguhr, f.o.b. mines, Cal	per ton	40.00 —	....
Kieselguhr, f.o.b. N.Y.	per ton	55.00 —	60.00
Magnesite, calcined	per ton	60.00 —	65.00
Pumice stone, imported	lb.	.03 —	.40
Pumice stone, domestic, lump	lb.	.05 —	.05½
Pumice stone, domestic, ground	lb.	.06 —	.07
Quarts (acid tower) first to head, f.o.b. Baltimore	net ton	..... —	10.00
Quarts (acid tower) 1½@2 in., f.o.b. Baltimore	net ton	..... —	14.00
Quarts (acid tower) rice, f.o.b. Baltimore	net ton	..... —	17.00
Quarts, lump, f.o.b. North Carolina	net ton	5.00 —	7.50
Shellac, orange fine	lb.	.68 —	.70
Shellac, orange superfine	lb.	.78 —	.80
Shellac, A. C. garnet	lb.	.58 —	.60
Shellac, T. N	lb.	.68 —	.70
Soapstone	ton	12.00 —	15.00
Sodium chloride	long ton	12.50 —	13.00
Talc, paper-making grades, f.o.b. Vermont	ton	11.00 —	18.00
Talc, roofing grades, f.o.b. Vermont	ton	8.50 —	13.00
Talc, rubber grades, f.o.b. Vermont	ton	11.00 —	18.00
Talc, powdered, Southern, f.o.b. cars	ton	7.50 —	11.00
Talc, imported	ton	30.00 —	40.00
Talc, California talcum powder grade	ton	18.00 —	25.00

Refractories

Bauxite brick, 56% Al, f.o.b. Pittsburgh	per ton		$50.00
Carborundum refractory brick, 9-in.	less than carlot	1,000	1250.00
	carload lots	1,000	1100.00
Chrome brick, f.o.b. Eastern shipping points	net ton		52– 55
Chrome cement, 40–45% Cr_2O_3	net ton		30– 32
Chrome cement, 40–45% Cr_2O_3, sacks, in car lots, f.o.b. Eastern shipping points	net ton		33– 35
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000		35– 40
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000		30– 35
Magnesite brick, 9-in. straight	net ton		65– 70
Magnesite brick, 9-in. arches, wedges and keys	net ton		77
Magnesite brick, soaps and splits	net ton		98
Silica brick, 9-in. sizes, f.o.b Chicago district	1,000		40– 42
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000		42– 45
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa	1,000		35– 38

Ferro-Alloys

All f.o.b. Works

Ferro-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00 —	225.00
Ferrochrome per lb. of Cr. contained, 6–8% carbon, carlots	lb.	.11 —	....
Ferrochrome, per lb. of Cr. contained, 4-6% carbon, carlots	lb.	.11 —	12
Ferromanganese, 76-80% Mn, domestic	gross ton	58.00 —	60.00
Ferromanganese, 76-80% Mn, English & German	gross ton	60.00 —	62.00
Spiegeleisen, 18-22% Mn	gross ton	25.00 —	27.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.25 —	....
Ferrosilicon, 10-15%	gross ton	38.00 —	40.00
Ferrosilicon, 50%	gross ton	57.00 —	59.00
Ferrosilicon, 75%	gross ton	120.00 —	125.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.40 —	.45
Ferrouranium, 35-50% of U, per lb. of U content	lb.	6.00 —	....
Ferrovanadium, 30-40% per lb. of contained V.	lb.	4.25 —	4.50

Ores and Semi-finished Products

All f.o.b. New York, Unless Otherwise Stated

Bauxite, 52% Al content	net ton	$8.00 —	$10.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 —	23.00
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	ton	22.00 —	23.00
Coke, foundry, f.o.b. ovens	net ton	4.25 —	4.50
Coke, furnace, f.o.b. ovens	net ton	3.25 —	3.50
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	15.00 —	.....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	20.00 —	22.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½ —	.01¾
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.22 —	.23
Manganese ore, chemical (MnO_2)	net ton	50.00 —	55.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.45 —	.50
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	30.00 —	.....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.12 —	.12
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.13 —	.13
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	.11 —	.12
Rutile, 95% TiO_2 per lb. ore	lb.	.15 —	.....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	2.50 —	2.75
Tungsten, Wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C.	unit	2.75 —	3.00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.25 —	1.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	.....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½ —	.13

Non-Ferrous Metals

New York Markets

	Cents per Lb.
Copper, electrolytic	13.125
Aluminum, 98 to 99 per cent	24.50@25.00
Antimony, wholesale lots, Chinese and Japanese	4.80@5.25
Nickel, ordinary (ingot)	41.00
Nickel, electrolytic	44.00
Monel metal, shot and blocks	35.00
Monel metal, ingots	38.00
Monel metal, sheet bars	40.00
Tin, 5-ton lots, Straits	28.375
Lead, New York, spot	4.67@4.70
Lead, E. St. Louis, spot	4.32@4.40
Zinc, spot, New York	5.15@5.20
Zinc, spot, E. St. Louis	4.70@4.75

OTHER METALS

Silver (commercial)	oz.	$0.70
Cadmium	lb.	1.00–1.25
Bismuth (500 lb. lots)	lb.	1.50@1.55
Cobalt	lb.	3.00@3.25
Magnesium (f.o.b. Philadelphia)	lb.	1.25
Platinum	oz.	85.00
Iridium	oz.	150.00@170.00
Palladium	oz.	55.00–60.00
Mercury	75 lb.	40.00–41.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.50
Copper bottoms	28.00
Copper rods	19.00@19.75
High brass wire	15.75
High brass rods	13.25
Low brass wire	17.25
Low brass rods	17.25
Brazed brass tubing	25.00
Brazed bronze tubing	29.75
Seamless copper tubing	19.50
Seamless high brass tubing	18.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York Current	Cleveland	Chicago
Copper, heavy and crucible	9.75@10.25	9.25	9.50
Copper, heavy and wire	9.25@9.50	8.50	8.50
Copper, light and bottoms	7.50@8.00	7.50	7.25
Lead, heavy	3.50@3.75	3.25	3.25
Lead, tea	2.25@2.35	2.25	2.25
Brass, heavy	4.25@4.50	4.50	5.00
Brass, light	3.25@3.50	3.25	3.50
No. 1 yellow brass turnings	4.00@4.25	4.25	4.50
Zinc	2.00@2.25	2.00	2.25

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Cleveland	Chicago
Structural shapes	$2.88	$2.88	$2.88
Soft steel bars	2.78	2.78	2.78
Soft steel bar shapes	2.78	2.78	2.78
Soft steel bands	3.42	3.48	3.48
Plates, ¼ to 1 in. thick	2.88	2.88	2.88

*Add 15c per 100 lb. for trucking to Jersey City and 10c for delivery in New York and Brooklyn

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

TUSCALOOSA—F. G. Blair, Tuscaloosa, will head the new company now being organized under the auspices of the local Chamber of Commerce, J. B. Brosius, secretary, to construct and operate a new plant for the manufacture of bond and kraft paper. The company will be capitalized at $2,000,000, and the new mills are estimated to cost close to $1,000,000. It is proposed to develop a daily production of about 50 tons.

California

MERCED—The California Pottery Co. has begun operations at its new local plant, placing 4 kilns, recently completed, in service. The initial unit will comprise a total of 16 kilns, and these will be completed and placed in operation as quickly as possible. Employment will be given to about 30 operatives, and this number will be gradually increased as the plant expands.

LOS ANGELES — The International Shales Process Co. has awarded a contract to the Golden State Construction Co., 415-17 Delta Bldg., for the erection of a series of distillation plants for oil-refining operations in California, Utah, Nevada and Colorado. Each plant unit is estimated to cost close to $90,000, and it is said that a total of 100 plants will be constructed. The first refinery will be located in Kern County.

Connecticut

NEW HAVEN—The New York, New Haven & Hartford R.R. Co. has awarded a contract to the American Creosoting Co., 17 Battery Pl., New York, for the erection of a new local creosoting treatment plant for railroad ties, with annual capacity of about 1,500,000 cross-ties. It is expected to have the plant ready for operation during the coming spring.

Delaware

SOUTH WILMINGTON—The Wilmington Sugar Refining Co. is pushing construction on its new local refinery, and expects to have the entire project completed within 24 months; certain units will be ready prior to this time and placed in operation. The plant will occupy a 12-acre site in the vicinity of B St., and will consist of a total of 10 buildings, estimated to cost, with machinery, in excess of $7,000,000. A wharf about 800 ft. long will be built along the Christiana River. The Armstrong & Latta Co., Land Title Bldg., Philadelphia, Pa., has the erection contract.

Illinois

CICERO—The Oriental Glass Manufacturing Co. has purchased 10 acres at West 33d St. and 52nd Ave., Cicero, for the erection of a glass factory to cost $175,000 and will manufacture colored sheet glass. The plant will be complete for operation within the next three months.

CHICAGO—Paul G. Carhardt, architect, is preparing plans for a 2-story concrete and mill construction dyeing plant, 500 x 150 ft., to be built at Grand Ave. near 54th Ave.

Maryland

POCOMOKE CITY—The Pocomoke City Roller Mills has preliminary plans under way for the erection of a new flour mill on local site. It will be 3-story and basement, 40 x 55 ft., and is estimated to cost about $35,000. Bids for construction are expected to be called near the close of the year. W. S. Jewell heads the company.

BALTIMORE—Fire, Oct. 29, destroyed one of the plants of the Baltimore Brick Co., Maryland Trust Bldg., at Highland Ave. and Monument St., with loss estimated at close to $100,000. The loss included 5 kiln buildings, machine shops, power house and other structures. It is said that the plant will be rebuilt. Warren Griffiss is general manager.

BALTIMORE—The Cooknut Corp., Lexington and Paca Sts., has construction under way on its new 4-story plant, 80 x 100 ft., on Canton St., to be equipped for the manufacture of lard substitutes, estimated to cost about $100,000 with machinery. W. R. Spruill is president.

CRISFIELD—The Standard Oil Co., Pratt St., Baltimore, is considering the construction of a large oil-distributing plant at Crisfield, and a number of available sites are being inspected. It is purposed to make this the main distributing works in the central Atlantic coast district, and extensive tankage and equipment will be provided.

Massachusetts

PITTSFIELD—The Pittsfield Lime & Stone Co. has plans under way for enlargements in its plant at Richmond Summit. Four new kilns will be constructed and present kilns altered and improved. New operating equipment will be installed.

ROXBURY—Fire, Oct. 31 destroyed a building at 10 Hampden St., occupied by the Chadwick-Boston Lead Co., for general service, with loss estimated at about $30,000.

BOSTON—The Tileston & Hollingsworth Co., 892 River St., Hyde Park, manufacturer of paper products, has construction under way on a new plant addition on River St., to be equipped as a paper washery. It is estimated to cost about $23,000. The Aberthaw Construction Co., 27 School St., Boston, has the erection contract.

WORCESTER—The American Steel & Wire Co. is building a 3-story addition to its South Works, 120 x 145 ft., estimated to cost about $150,000. It is expected to have the structure ready for service at an early date.

Minnesota

MINNEAPOLIS—The Minnesota Mfg. Co., 722 North Third St., manufacturer of sweeping compounds and other chemical specialties, is taking new bids for the erection of a 3-story plant on Eighth Ave., near Third St., estimated to cost about $35,000. It will be 46 x 130 ft. E. J. Miller is secretary.

Missouri

SPRINGFIELD — The Bromite White Lime Co., Woodruff Bldg., is considering the erection of a new 2-story and basement plant, with cost estimated at about $50,000. It is expected to have plans drawn at an early date. D. F. Klepinger is secretary.

COLUMBIA—The Edwards Brick Co., St. Louis, recently reorganized with a capital of $50,000, is planning for the establishment of a new plant at Columbia for the manufacture of brick and other burned clay products. S. E. Cullom is ceramic engineer for the company.

Nebraska

OMAHA—The Omaha Semi-Steel Foundry Co., 1409 Jackson St., has taken bids for the erection of a new 1- and 2-story foundry at Eleventh and Grace Sts., 60 x 100 ft., and will commence construction at an early date. W. F. Gernandt, 701 O. L. & B. Association Bldg., is architect.

New Jersey

NEWARK—Fire, Oct. 29, destroyed a portion of the plant of the Thrift Rubber Co., Woolsye St., Irvington, with loss estimated at about $10,000.

WHARTON—The Replogle Steel Corp. is completing extensions and improvements at its local plant, under way for some time past, and will hold the works in readiness to operate as soon as market conditions warrant. The steel plant consists of two blast furnaces and a sintering plant, with auxiliary departments, said to be valued in excess of $5,000,000.

EDGEWATER—The Archer Daniels Linseed Co., 20 Ninth Ave., Minneapolis, Minn., has awarded a contract to the Tilt-Hargan Co., 90 West Broadway, New York, for the erection of its new plant at Edgewater. It will consist of a main 3-story oil works, 150 x 250 ft.; three 1-story warehouse buildings; four grain tanks, each about 100 ft. high; and electric power plant for operation. Work will be commenced at once. Samuel Mairs is secretary.

North Carolina

MONROE—The Henderson Rolling Mills Co. has awarded a contract to J. S. Sterns, Monroe, for the erection of a new flour mill on local site, estimated to cost about $40,000. J. E. Henderson is president.

CHARLOTTE — The North Charlotte Creosoting Co., recently organized with a capital of $100,000, is planning for the erection of a new creosoting plant for timber treatment, with initial capacity of about 50,000 ft. of material per day. A retort, 68 ft. long, will be constructed in connection with the other works departments.

Ohio

ASHTABULA—The Silurim Mfg. Co., 421 Sloan Bldg., Eugene W. Steinbrenner, president, has plans under way for the erection of a new plant at Ashtabula, for the manufacture of rubber insulating materials. It will be 4-story, brick, and is estimated to cost in excess of $750,000, including machinery. Alfred W. Harris, Schofield Bldg., Cleveland, is architect.

YOUNGSTOWN—The Vahey Oil Co. has plans under way for the erection of a new 1-story building on West Rayen St. Stanley & Scheibel, Wick Bldg., are architects. W. H. Vahey is president.

AKRON—A. C. Horrocks, formerly connected with the local plant of the Goodyear Tire & Rubber Co., has organized a new company with capital of $50,000, for the manufacture of rubber specialties. The new organization has leased the plant of the Denmead Rubber Co., and will commence operations at an early date.

Pennsylvania

PHILADELPHIA—Horace T. Potts & Co., 316 North Third St., manufacturer of iron and steel products, has broken ground for the erection of a new 1-story foundry at Erie Ave. and D Sts., to be used in connection with an extensive new plant at this location. The William Steele & Sons Co., 1600 Arch St., is contractor.

SCRANTON—The Diamond Oil & Paint Co., 211-19 South Seventh Ave., has taken bids and will soon award contract for the erection of a new 2-story building, 60 x 100 ft., on Seventh Ave., estimated to cost about $60,000. Edward J. Lynott is president.

PHILADELPHIA—The Wittman Moriarty Co., Fourth and Vine Sts., manufacturer of leather products, has taken bids for the erection of an addition to its tanning plant at Ontario and C Sts. Work will be commenced at an early date.

South Carolina

SPARTANBURG—Caldwell & Co., manufacturers of cottonseed products, are planning for the erection of a new plant, about 25 x 65 ft. Ralph M. Caldwell is secretary and manager.

Tennessee

KNOXVILLE—The Knoxville Fertilizer Co. has awarded a contract to the Foundation Co., 120 Liberty St., New York, for the erection of its proposed new plant in Vestal section, to be 154 x 350 ft., and estimated to cost about $200,000. The plant will be equipped for an annual output of about 50,000 tons of acid phosphate. Manley & Young 814 West Hill Ave., are engineers. James W. Dean is secretary-treasurer.

Texas

MEXIA—The Texas-Mexia Co. will soon commence the installation of a 50-bbl. still at its properties, and plans for the installing of other equipment at its refinery for increased output.

DALLAS—The Superior Chemical Products Co., recently organized, has acquired the plant of the Southern States Chemical Co., and will use the works for the manufacture of general chemicals for fire-extinguishing and other service.

WACO—The Southwestern Portland Cement Co., El Paso, has preliminary plans under way for its proposed new mill in the vicinity of Waco, estimated to cost in excess of $2,000,000. O. J. Binford is secretary.

Virginia

LYNCHBURG—The Kerr & Wilson Co. has completed plans and will soon commence the erection of a new plant at South Roanoke, Va., for the manufacture of wood extract products. It will be 1-story, 80 x 130 ft.; estimated cost about $30,000.

West Virginia

MORGANTOWN — The University of West Virginia has preliminary plans under way for the erection of a new chemical laboratory, estimated to cost about $400,000. Bids will be asked early in 1922. Lee Coulter is dean.

Industrial Notes

BEN L. WHITNEY, formerly with the Byers Company, has opened an office at 528 Detroit Savings Bank Bldg., Detroit, Mich., as representative of Orton & Steinbrenner Co., manufacturer of material handling machinery, coal crushers, drag-line excavaters, locomotives, etc.

THE YORK HEATING & VENTILATING CORP., Philadelphia, Pa., announces that Thornton Lewis, who for the last fifteen years has been associated with the Buffalo Forge Co. and actively identified with the heating, ventilating and air-conditioning profession, has joined the organization as vice-president and general manager. He is a member of the executive committee in charge of the research laboratory established by the American Society of Heating and Ventilating Engineers at the Bureau of Mines, Pittsburgh. During the war period Mr. Lewis was consulting engineer for the du Pont companies of Wilmington, Del., having charge of the design and supervision of all heating, ventilating and drying installations. This company recently moved from York, Pa., to Bridgeport, Pa., where it has a plant of 50,000 sq.ft. of floor space with a 400-ft. frontage on the Reading railroad.

THE QUIGLEY FURNACE SPECIALTIES CO., INC., New York, announces that its pulverized fuel department has been acquired by the Hardinge Co., New York. The Hardinge Co. states there will be no change in the method of conducting the business at its offices, as the organization of the engineering department has been taken over practically intact. This transfer will in no way affect the refractory specialties business, which includes the manufacture and sales of Hytempite, Insulbrix and Insuline products.

CHICAGO PNEUMATIC TOOL CO. advises the public that it has brought suit in the United States District Court in the Western District of Michigan against the Keller Pneumatic Tool Co. for injunction and accounting of profits and damages due to alleged infringements of certain United States patents by their manufacture and sale of the so-called "Keller-Master Super-Hammer." The patents involved are Nos. 879,106, 897,958, 1,029,082 and 1,126,096. Suit has also been brought against the H. Channon Co. in the United States District Court at Chicago for alleged infringement by the sale and offering for sale of the above-mentioned Keller hammers and for unfair competition by acts calculated to produce confusion in the trade. These suits should not be confused with the one heretofore brought against the Keller Pneumatic Tool Co. in the United States District Court at Philadelphia for alleged infringement of patents 730,887, 822,147, 866,573 and 917,242, which suit is being vigorously prosecuted. Suit it also pending in the United States District Court at Chicago against the Keller Pneumatic Tool Co. for alleged infringement by the use of the trade name "Keller" and certain other trademarks of the Chicago Pneumatic Tool Co.

Capital Increases, Etc.

THE METROPOLITAN OIL CORP., Indianapolis, Ind., a Delaware corporation, has filed notice of increase in capital from $5,000,000 to $10,000,000.

THE LOUIS J. ROBINSON TANNING CO., a New Jersey corporation, has filed notice of organization to operate in New York, with capital of $100,000. The company is represented by L. J. Robertson, 450 West End Ave.

THE MANITO CHEMICAL FERTILIZER CO., 1205 Lehmann Bldg., Peoria, Ill., has filed notice of change of name to the Manito Chemical Co., at the same time increasing its capital from 2,000 shares of stock, no par value, to $150,000.

THE OJOT CHEMICAL CO., INC., Syracuse, N. Y., has filed a voluntary petition in bankruptcy, with liabilities stated at $20,317 and assets, $6,975.

THE MICHIGAN PAINT CO., Detroit, Mich., has filed notice of dissolution under state laws.

THE ACORN BRASS MFG. CO., 426 South Clinton St., Chicago, Ill., has filed notice of reduction in capital from $30,000 to $15,000.

THE TAYLOR-WARTON IRON & STEEL CO., 30 Church St., New York, N. Y., manufacturer of alloy steel and iron castings, etc., with plant at High Bridge, N. J., has arranged for a bond issue to total $3,250,000.

Daniel J. O'Connell has been appointed receiver for the HAMILTON PAPER BOX CO., 69 Greene St., New York, N. Y.

New Companies

THE PHILADELPHIA ASBESTOS CO., Philadelphia, Pa., has been incorporated with a capital of $12,000, to manufacture asbestos products. J. W. Hoffman, Jr., 5226 North Fairhill St., is treasurer.

THE MIOLA CHEMICAL CORP., Montclair, N. J., has been incorporated with a capital of $25,000, to manufacture chemical products. The incorporators are Paul H. Sullivan, Charles S. Shirley and James E. Lally, 88 Grove St., Montclair.

THE AMERICAN-MEXICAN REFINING CO., 11 South La Salle St., Chicago, Ill., has been incorporated with a capital of $100,000, to manufacture refined oil products. The incorporators are N. O. Johnson, D. A. Tasiopoulos, and Henry L. Blim.

THE CLAY CRAFT POTTERIES, INC., Los Angeles, Cal., has been incorporated with a capital of $300,000, to manufacture pottery specialties. The incorporators are E. R. Carpenter, Los Angeles; W. P. Yoo and M. H. Carpenter, Glendale, Cal.

THE NEPON DRUG & CHEMICAL CO., Rockaway Park, L. I., has been incorporated with a capital of $50,000, to manufacture chemicals, chemical byproducts, drug specialties, etc. The incorporators are T. J. Smith, G. F. Wolfe and J. Clark. The company is represented by Joseph Shalleck, 152 West 42d St., New York.

THE REED & FIBRE CORP., Gardner, Mass., has been incorporated with a capital of $50,000, to manufacture fiber products and affiliated specialties. Maurice J. Taub is vice-president; and Nathan Gewandter, 62 A St., Gardner, treasurer.

THE EAGLE CEMENT CORP., Jersey City, N. J., has been incorporated with a capital of $150,000, to manufacture cement products. The company is represented by the United States Corporation Co., 15 Exchange Pl., Jersey City.

THE UNION BLUE CORP., New York, N. Y., has been incorporated with a capital of $50,000, to manufacture blueing, chemical specialties, etc. The incorporators are S. and L. Pressner, and B. Frankel. The company is represented by G. C. Young, 165 Broadway, New York.

THE ROMANITE PRODUCTS CORP., Buffalo, N. Y., has been incorporated with a capital of $500,000, to manufacture tile specialties, composition products, etc. The incorporators are E. A. Willson, A. L. Kink and R. M. Houser, 702 Mutual Life Bldg., Buffalo.

THE CHICAGO CHINA DECORATING WORKS, INC., 1529 West 21st St., Chicago, Ill., has been incorporated with a capital of $20,000, to manufacture chinaware and other pottery products. The incorporators are Jacob Williamson, Edwin M. Conway and R. E. Leopold.

THE SOUTHERN PINE PRODUCTS CO., Biloxi, Miss., has been incorporated under Delaware laws with capital of $2,000,000, to manufacture turpentine, rosin and kindred products. The incorporators are D. J. and E. C. Gay, Biloxi; and J. O. Gillespie, Gulfport, Miss. The company is represented by the United States Corporation Co., 65 Cedar St., New York.

THE LANSDALE PORCELAIN ENAMEL WORKS, INC., Lansdale, Pa., has been incorporated with a capital of $30,000, to manufacture porcelain products and other ceramic specialties. Abraham H. Landis, Lansdale, is treasurer.

THE PROGRESS PROCESS CO., Louisville, Ky., has been incorporated under Delaware laws with capital of $660,000, to manufacture chemicals, chemical byproducts, etc. The incorporators are T. K., J. Blakely and James P. Helm, Louisville. The company is represented by the Corporation Trust Co. of America, duPont Bldg., Wilmington, Del.

THE SALINA CHEMICAL CO., Syracuse, N. Y., has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. The incorporators are C. J. Dence, C. E. Brownell and M. B. Eldredge. The company is represented by C. R. Milford, Skaneateles, N. Y.

THE JEWEL MFG. CO., Lansing, Mich., has been incorporated with a capital of $30,000, to manufacture soaps, chemical products, etc. The incorporators are Louis Simon and Herman C. Nielsen, Lansing, Mich.

THE FEDERAL PAINT & VARNISH CO., Boston, Mass., has been incorporated with a capital of $25,000, to manufacture paints, varnish, etc. Benjamin J. Bond is president; and E. C. Meyer, 24 Seaver St., Roxbury, Mass., treasurer.

KIRBACH, INC., New York, N. Y., has been incorporated with a capital of $50,000, to manufacture chemicals and chemical byproducts. The incorporators are H. Kirbach, E. G. Hothorn and F. R. Fox. The company is represented by C. S. Aronstam, 100 Broadway, New York.

INDUSTRIAL LABORATORIES, INC., 1 Montgomery St., Jersey City, N. J., has been incorporated with a capital of $100,000, to manufacture chemicals and chemical byproducts. The incorporators are Frank E. Williamson, Carl W. von Helmolt and William G. Clarke.

THE EDIBLE OILS REFINING CORP., 140 South Dearborn St., Chicago, Ill., has been incorporated with a capital of $20,000, to manufacture refined oil products. The incorporators are Taylor E. Brown, Clifford J. Thompson and David E. Peterson.

THE PEERLESS TANNING CO., Salem, Mass., has been incorporated with a capital of $10,000, to manufacture leather products. Theodore T. Granes is president; and Wallace F. Haley, 35 Pleasant St., Salem, treasurer.

THE PURITAN PETROLEUM CO., New York, N. Y., has been incorporated under Delaware laws with capital of $5,000,000, to manufacture oil products. The company is represented by the United States Corporation Co., 65 Cedar St., New York.

THE NILE QUEEN CORP., 3425 Indiana Ave., Chicago, Ill., has been incorporated with a capital of $200,000, to manufacture chemicals and chemical byproducts. The incorporators are J. Delos Bell, George H. Walker and Claude A. Barnett.

Coming Meetings and Events

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE will hold its seventy-fourth meeting at Toronto, Canada, Dec. 27 to 31, 1921.

AMERICAN CERAMIC SOCIETY will hold its twenty-fourth annual meeting at St. Louis, Feb. 27 to March 2, 1922.

AMERICAN ENGINEERING COUNCIL will hold its next meeting in Washington, Jan. 5-6.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its annual winter meeting at Baltimore, Md., Dec. 6 to 9. Headquarters will be at the Emerson Hotel.

AMERICAN IRON AND STEEL INSTITUTE will hold its twentieth general meeting at the Hotel Commodore, New York City, on Friday, Nov. 18.

AMERICAN PETROLEUM INSTITUTE will hold its second annual meeting at the Congress Hotel, Chicago, Dec. 6, 7 and 8.

COLLEGE OF THE CITY OF NEW YORK, department of chemistry, will give public lectures under the auspices of the City College Chemical Society in the Doremus Lecture Theater, at 4:30 p.m., as follows: Nov. 17, "The Significance of the Coal Tar Dye Industry," by Dr. Ellwood Hendrick, consulting Editor, CHEM. & MET.; Nov. 30, "Afterthoughts of the War," by Leland L. Summers, of the War Industries Board; Dec. 6, "America in Chemistry," by Dr. Edgar F. Smith, provost emeritus, University of Pennsylvania, and president, American Chemical Society.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

STAMFORD CHEMICAL SOCIETY, Stamford, Conn., holds a meeting in the lecture room of the local high school on the fourth Monday of each month, except June, July, August and September.

The following meetings are scheduled to be held in Rumford Hall, the Chemists' Club, New York: Nov. 18—American Electrochemical Society, regular meeting; Dec. 2—Society of Chemical Industry, regular meeting; Dec. 9—American Chemical Society, regular meeting. Jan. 6—American Chemical Society, regular meeting; Jan. 13—Society of Chemical Industry, Perkin Medal; Feb. 10—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting; March 10—American Chemical Society, Nichols Medal; March 24—Society of Chemical Industry, regular meeting; April 21—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting; May 5—American Chemical Society, regular meeting; May 12—Société de Chimie Industrielle (in charge), American Chemical Society, Society of Chemical Industry, American Electrochemical Society, joint meeting; May 19—Society of Chemical Industry, regular meeting; June 9—American Chemical Society, regular meeting.